ELECTRICAL REVIEW

FRIDAY
DECEMBER 1960

WEEKLY
PRICE 1s 6d

POWER

1/25th to 600 horsepower

BROOK
ELECTRIC
MOTORS

LEHIGH UNIVERSITY
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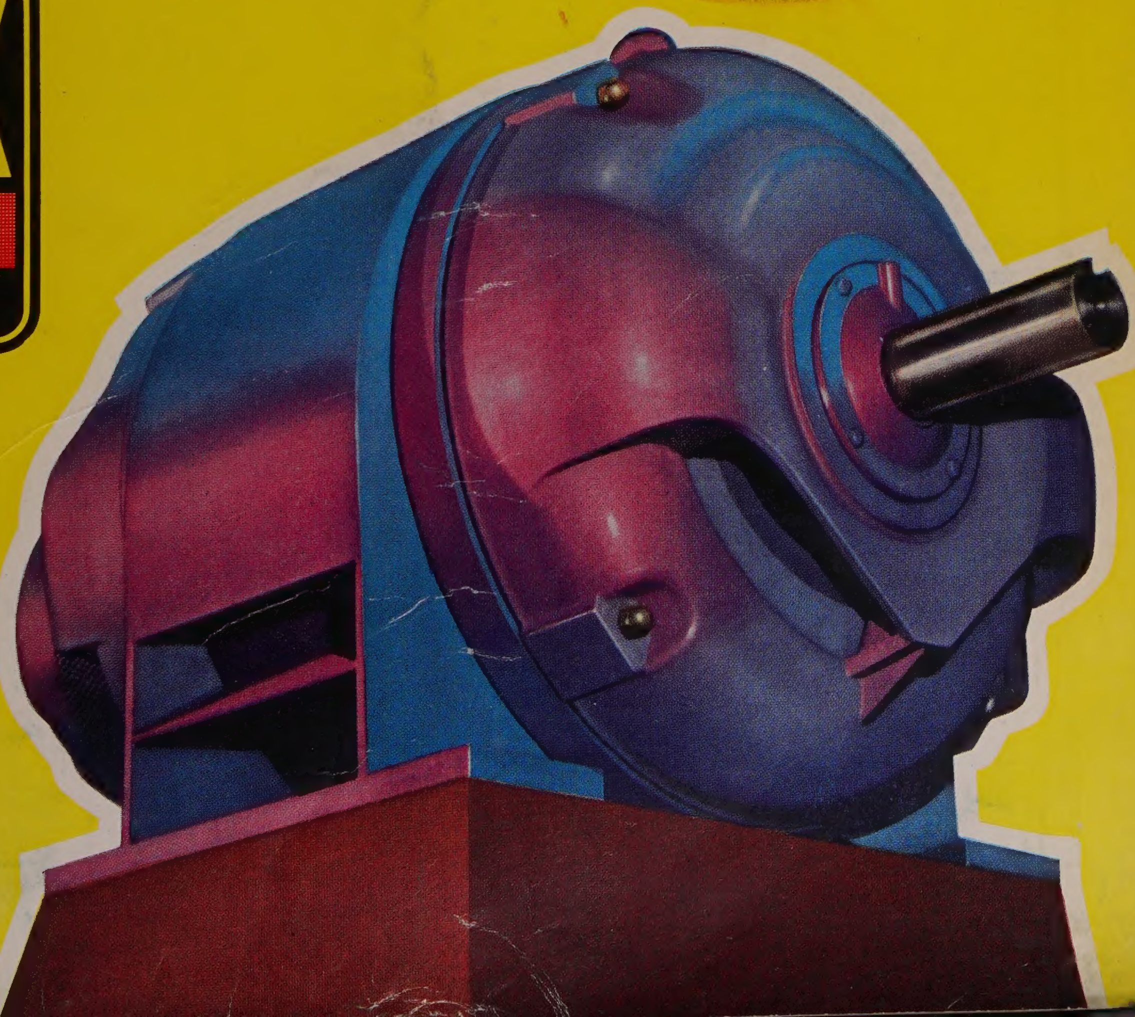

6

BROOK MOTORS LTD.
HUDDERSFIELD

'Sky-Line'...in single, elegant fittings or coupled in flowing lines for hotels, stores, supermarkets, offices and all commercial areas. *Please write for illustrated brochure.*

better lighting by BENJAMIN REGD.

THE BENJAMIN ELECTRIC LTD
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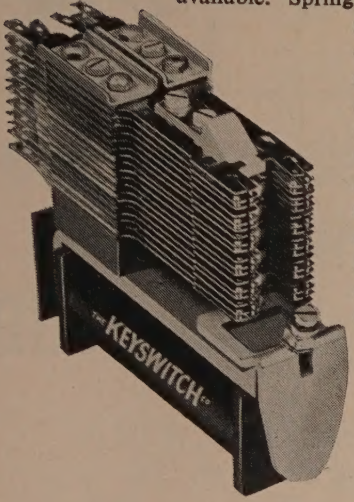
Smee's 162

Men in the Know

HAVE THE RIGHT CONTACTS

MAJOR TYPE 'BPO 3000'

The best known and most useful relay available. Spring sets allow from one make or break to 12 changeovers. For minute or heavy switching. Sensitivity down to 20 milliwatts. Adjustable for critical timing, fast or slow operation. Standard or Tropical finish. Special adaptations can be supplied.



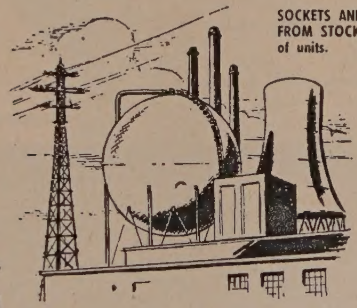
Transparent covers for above now available.

and now PLUG-IN 3000 Type Relays.

Plug-in facilities in addition to all the versatility and well-established, reliable features of the world's best known relays.

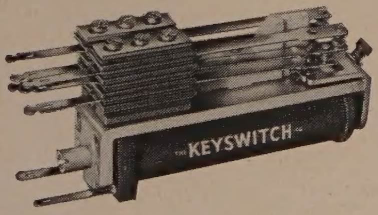
- ★ Positive contact between male and female pins.
- ★ Contacts: up to 18 light duty or 12 heavy duty.
- ★ Complete transistorized units.
- ★ AC or DC operation.
- ★ Transparent or metal cover.
- ★ Clip retains relay positively in any position.

SOCKETS AND FITTINGS ARE AVAILABLE FROM STOCK for immediate assembly of units.



PLUG-IN TRANSISTORIZED UNIT.

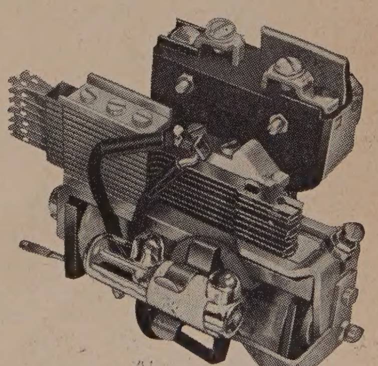
Operation AC or DC. Switching or Signal Current AC or DC. 5 to 500 micro-amps. Transfer switching current 10 *amps. or* 500*v.*



MINOR TYPE '600' (Fitted with double pole changeover for 250 volts 2 amps.)

Ideal for simple switching operations where lightness, compactness and economy are prime considerations. When fitted with contacts similar to those of the 'B.P.O. 3000' type it is faster in operation and release.

This relay incorporates 15 amp. Micro Switch; 5 amp. Mercury Switch and standard 0·3 to 8 amp. contacts.



Available free on request, unique calculator providing full relay specifications

KEYSWITCH
RELAYS

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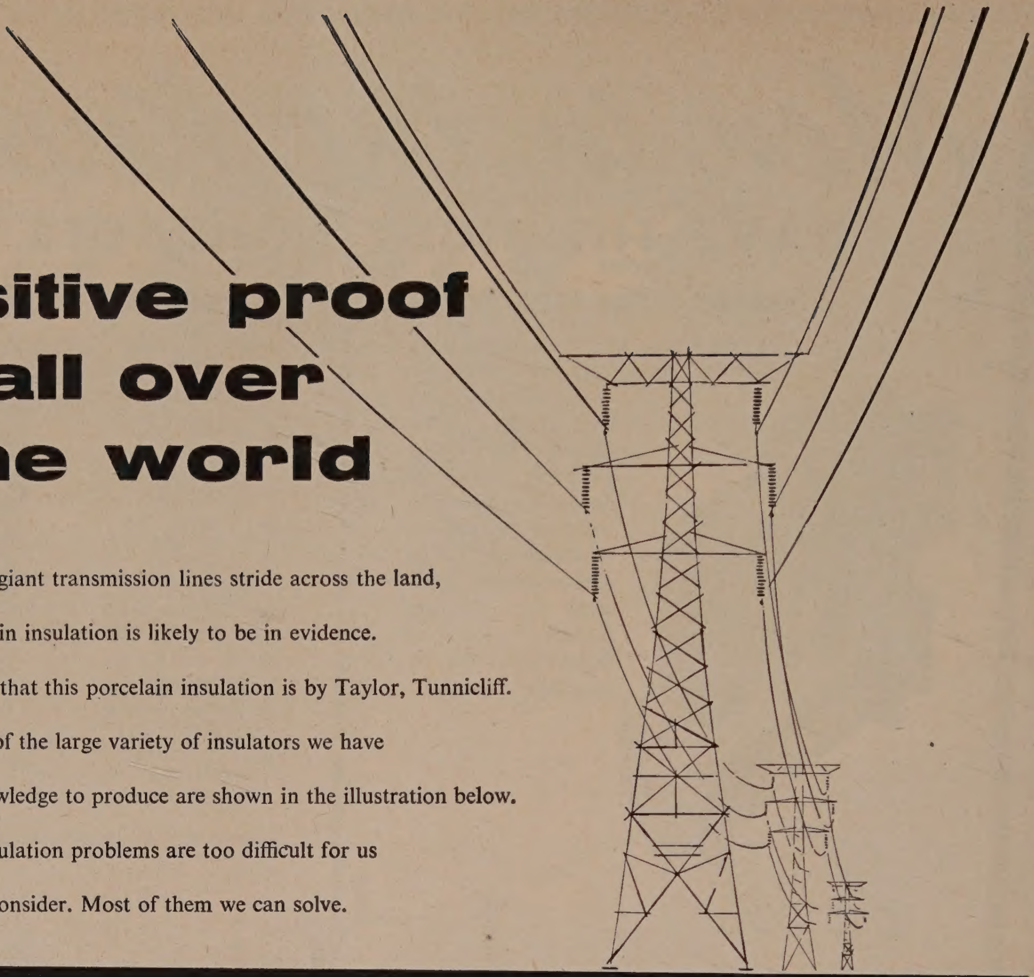
London, W.2
Telephone: PADdington 2231

Extremely advantageous quotations can be offered for quantity orders.
Contractors to Home and Overseas Governments and H.M. Crown Agents.

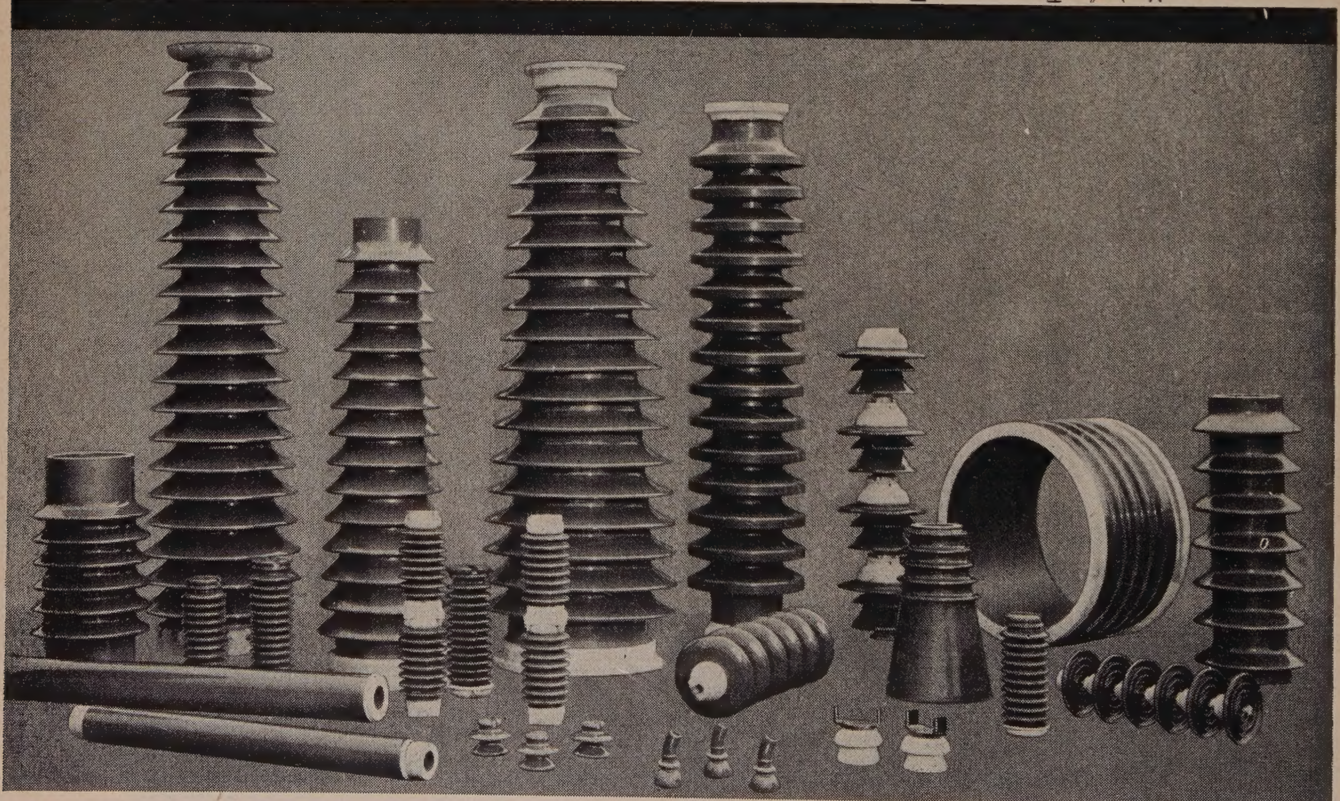
RELAYS FOR ALL PURPOSES can be manufactured to customers' requirements for :—

AUTOMATION
COMPUTERS
BATCH COUNTING and PHOTO-ELECTRICS
TELEPHONY and INTERCOM SYSTEMS
AUTO-TIMING and AUTOMATIC SIGNALS
MOTOR and MACHINERY CONTROL
CURRENT and VOLTAGE REGULATION,
Etc.



Positive proof all over the world

Wherever the giant transmission lines stride across the land,
porcelain insulation is likely to be in evidence.
And the chances are that this porcelain insulation is by Taylor, Tunnicliff.
A few of the large variety of insulators we have
the capacity and knowledge to produce are shown in the illustration below.
No insulation problems are too difficult for us
to consider. Most of them we can solve.



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Head Office: EASTWOOD · HANLEY · STOKE-ON-TRENT · Tel: STOKE-ON-TRENT 25272-5
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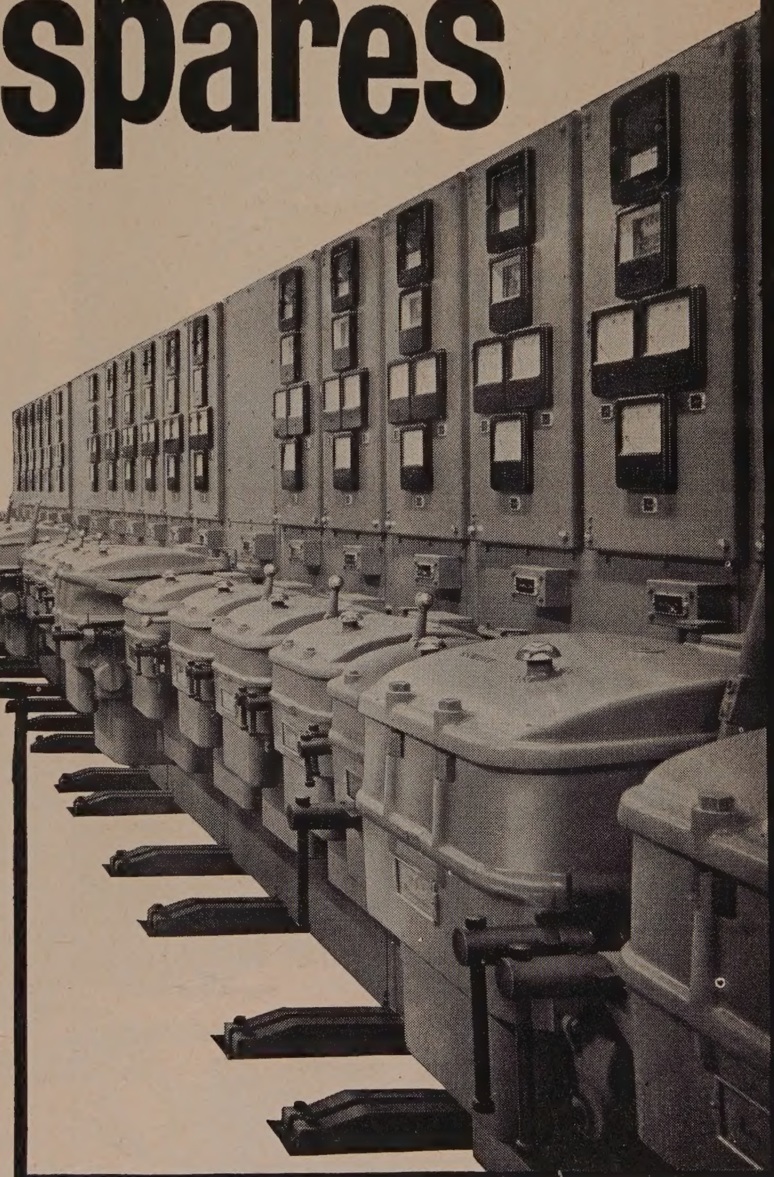
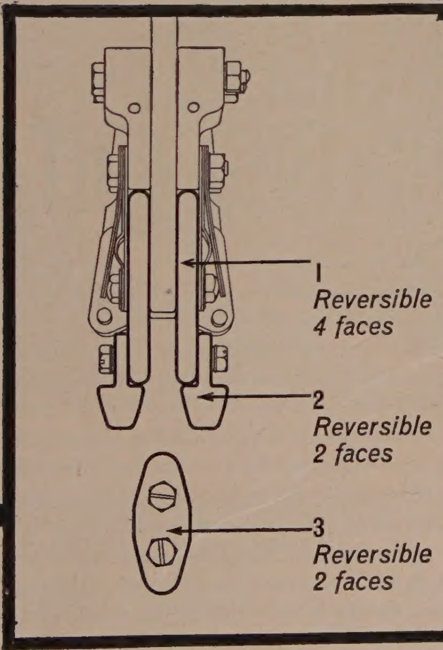
EMERGENCY MAINTENANCE!

Built-in-spares

eliminate delay with Ellison GEO switchgear

ASTA CERTIFIED TO B.S.116:1952





Did you know that the Ellison GEO switchgear has *built-in-spares?*

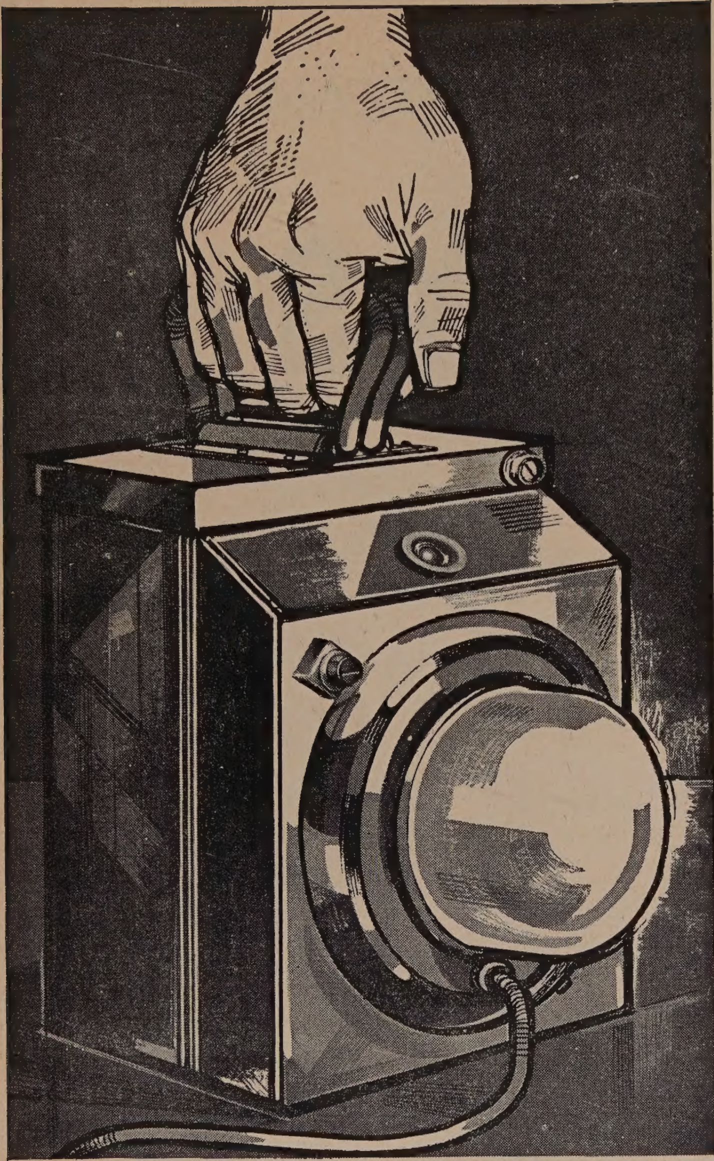
All contacts on the 400, 600, 800 and 1200 amp size circuit breakers are interchangeable and reversible—the arc contacts in a matter of minutes.

This is but one of the easy maintenance features that characterise Ellison GEO switchgear. May we send you further information?

TRADE MARK

GEORGE ELLISON
LIMITED

PERRY BARR · BIRMINGHAM 22B



NOW! EMERGENCY LIGHTING WHEREVER YOU NEED IT–

CHEAPLY, EASILY

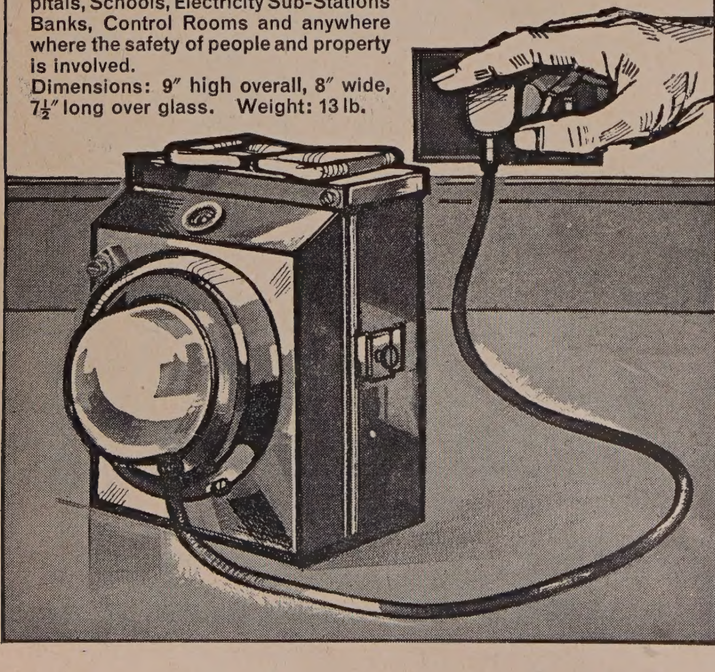
WITH

THE NEW NIFE PORTABLE EMERGENCY LIGHTING UNIT RE6

PLUG IT IN WHERE YOU WANT IT

Offices, Factories, Fire Stations, Hospitals, Schools, Electricity Sub-Stations Banks, Control Rooms and anywhere where the safety of people and property is involved.

Dimensions: 9″ high overall, 8″ wide, 7½″ long over glass. Weight: 13 lb.



* Automatic emergency lighting. Upon failure of the 220/250 volt A.C. mains, a relay closes and automatically connects the lamp bulb to the battery.

* Instantly installed where permanent schemes are impracticable and where the unit can be taken to a central charging point from time to time.

* Incorporates a Nife all-steel alkaline battery for long, trouble-free service with minimum of maintenance.

* The Nife battery will stand idle for long periods without deterioration, making trickle-charging entirely unnecessary.

* The lamp contains a double filament bulb and the battery will power the 3 watt filament for about 20 hours or the 18 watt filament for 3 hours per charge.

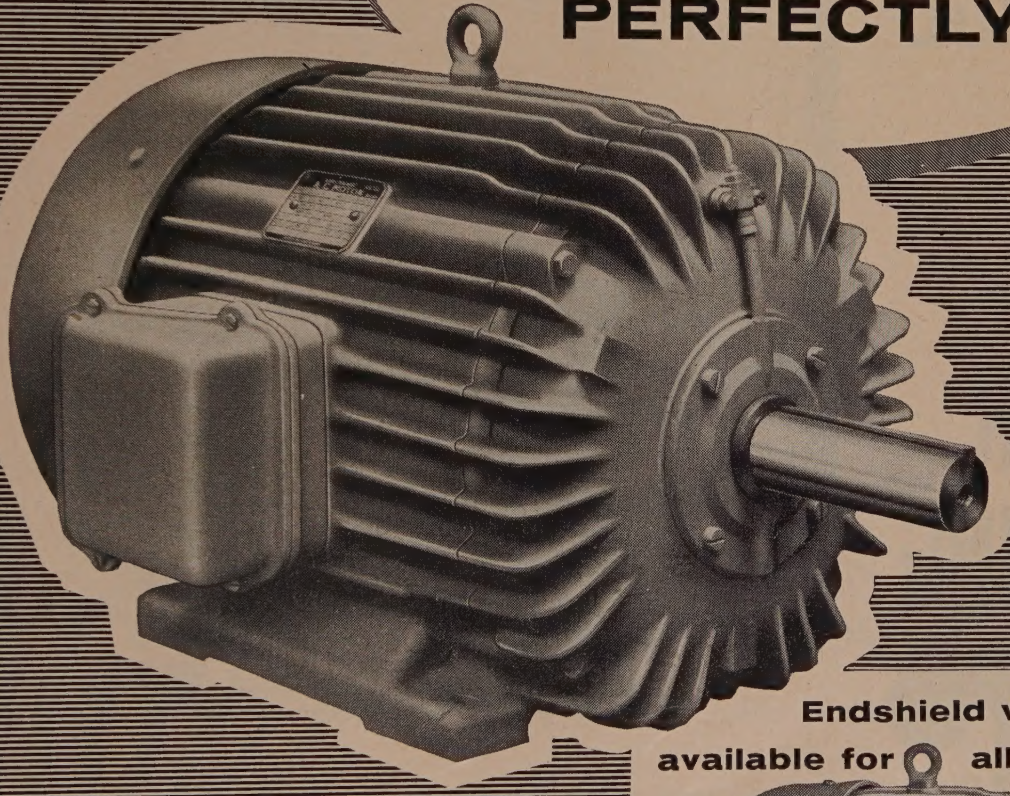
* Fitted with domed translucent well glass providing intense all-round illumination.

YOU GET MORE LIFE FROM NIFE

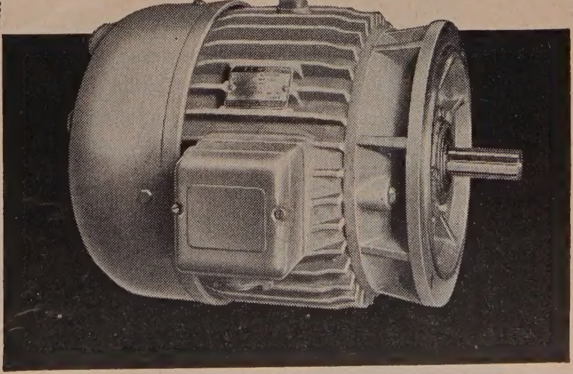
Send for details of our portable lamp range to:
Nife Batteries, Redditch, Worcestershire.

AEI British Standard Dimension Motors (BS2960 Pt 2)

MEASURE UP PERFECTLY



Endshield versions available for all ratings



Interchangeable with drip-proof machines to B.S. 2960 (Pt1)

Class 'E' insulation

High power/weight ratio

Compact construction

NOW AVAILABLE UP TO 50 H.P.

AEI

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Associated Electrical Industries Limited

Motor and Control Gear Division

RUGBY AND MANCHESTER, ENGLAND

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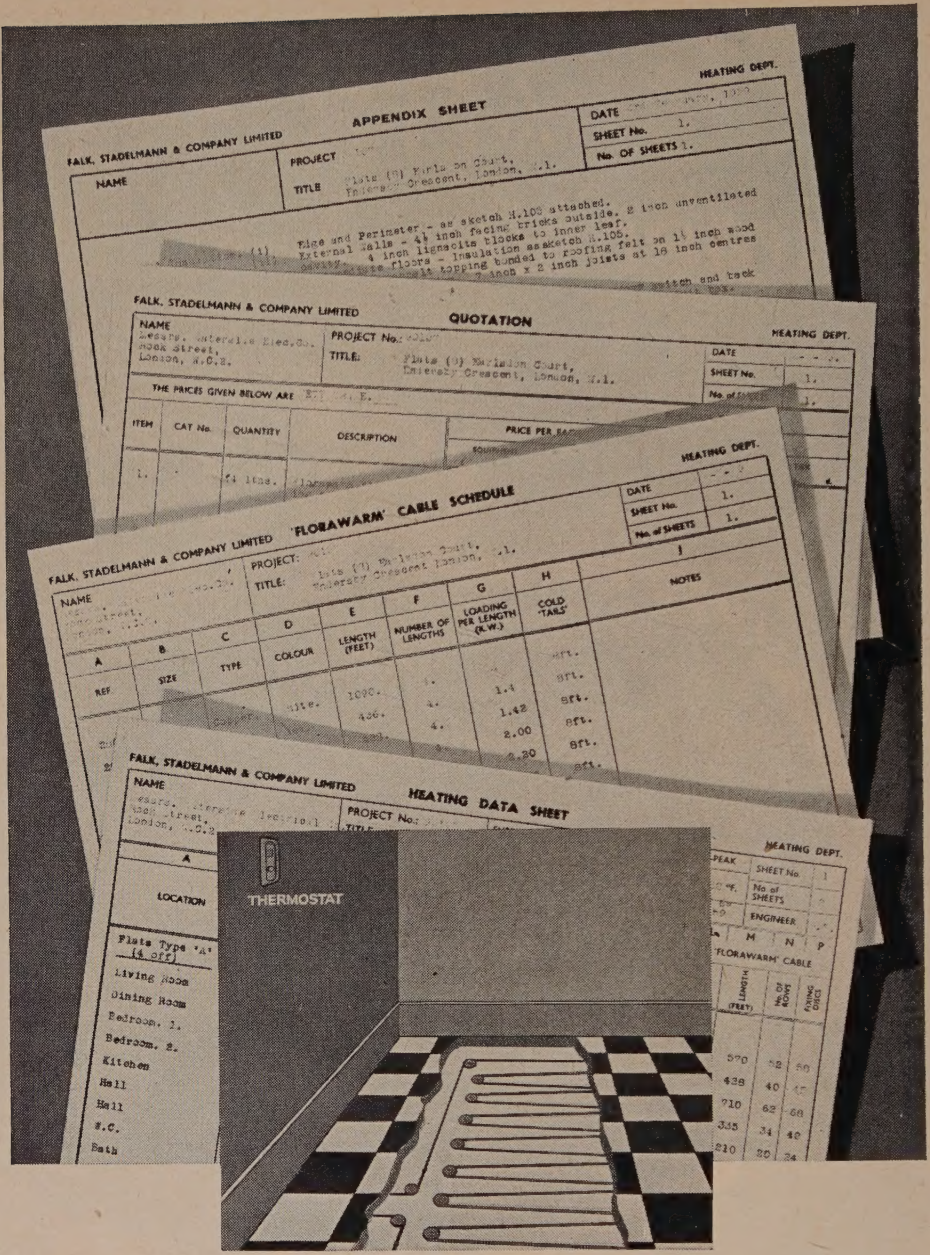
FALKS OFFER ALL-OVER SERVICE on UNDER-FLOOR HEATING



FALKS HEATING DESIGN SERVICE is freely available for the complete design and recommendation for an individual FLORAWARM FLOOR-WARMING SYSTEM from your scale plans and sections.

The illustrated documents—covering part of a FALKS FLORAWARM specification for a typical block of flats—demonstrate the comprehensive nature of this service.

florawarm

Patent application No. 807/57 (REGD.)

Developed by
Wandleside Cable Works Ltd.
One of the FALKS Group.

For further information on the FLORAWARM SYSTEM and the FALKS SERVICE please apply to your nearest FALKS branch for leaflets P.2733 and P.2785.

Monitor sets for use during laying and screeding are available for purchase or hire.

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FALK, STADELMANN & CO. LTD

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AP156

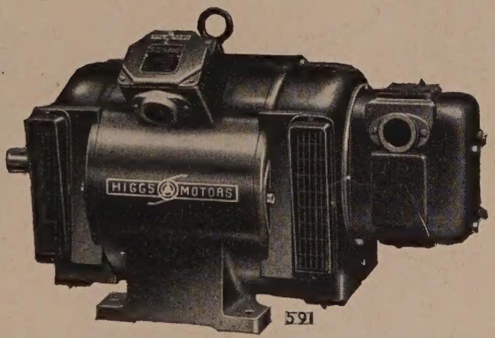
TRADE

HIGGS MOTORS LTD.

MANAGING DIRECTOR DAVID C.Y. HIGGS. A.M.I.E.E.

MARK

BIRMINGHAM 6 ENGLAND



SLIP RING MOTORS up to **1000 H.P.**

MOTORES DE ANILLOS ROZANTES de hasta 1.000 h.p.

GUARANTEED FOR EVER

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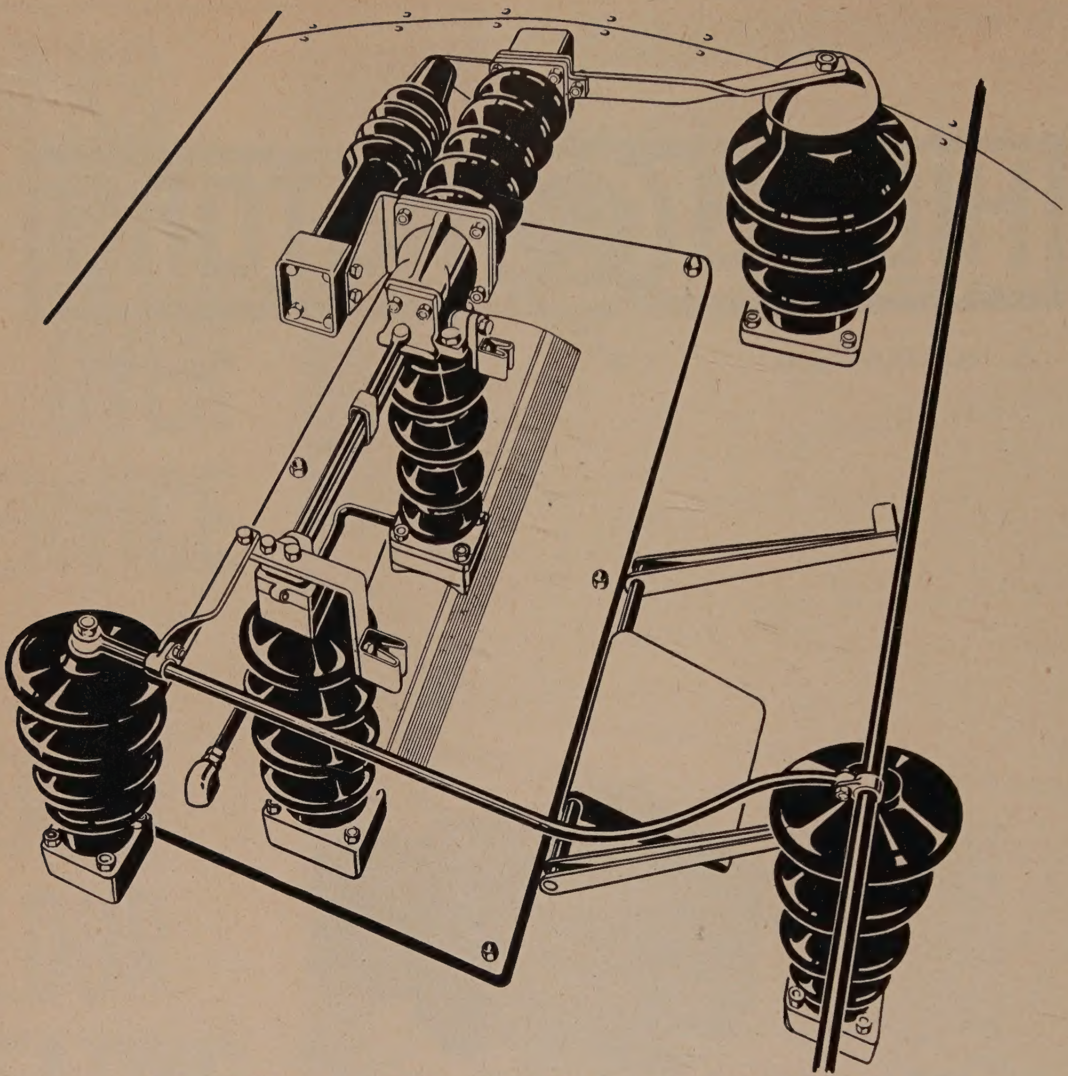


MAIN-LINE ELECTRIFICATION

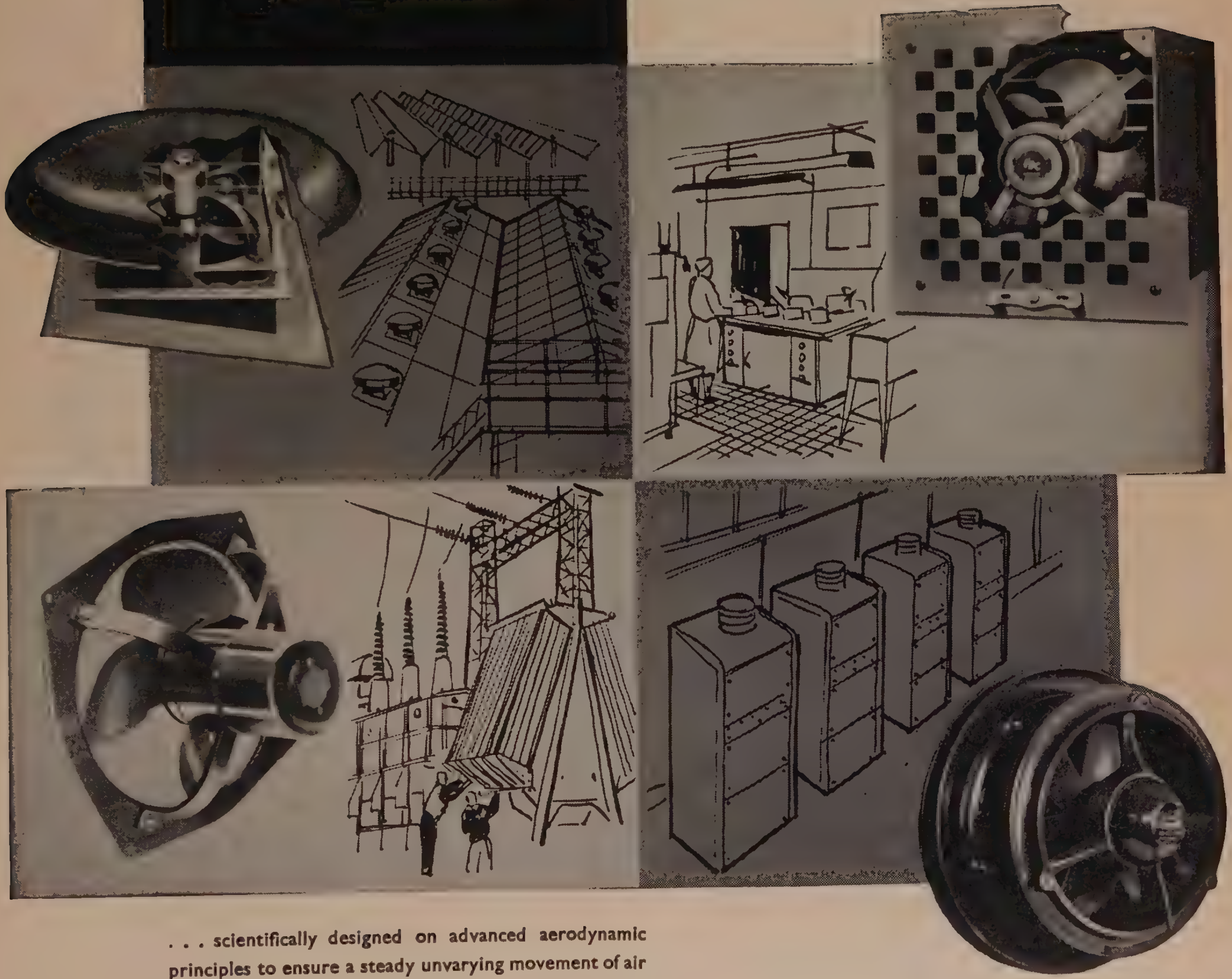
This Reyrolle 25-kV single-phase air-blast circuit-breaker has been designed specifically to control the incoming supply to electric locomotives

400 amperes current rating.
250-MVA breaking capacity at 25 kV.
Compact and robust construction.
Simple six-bolt fixing to roof of cab.
Immediate access to all major working-parts to facilitate maintenance.
Operation from locomotive's compressed-air system.

Reyrolle

Hebburn - County Durham - England

FANS
for
every
purpose....



. . . scientifically designed on advanced aerodynamic principles to ensure a steady unvarying movement of air unaffected by external conditions.

In addition to manufacturing standard ranges of fans, Fenton Byrn will always welcome this opportunity to consider and manufacture fansf or special purposes. You are invited to submit your enquiries and proposals to the Fenton Byrn Research and Development Department.

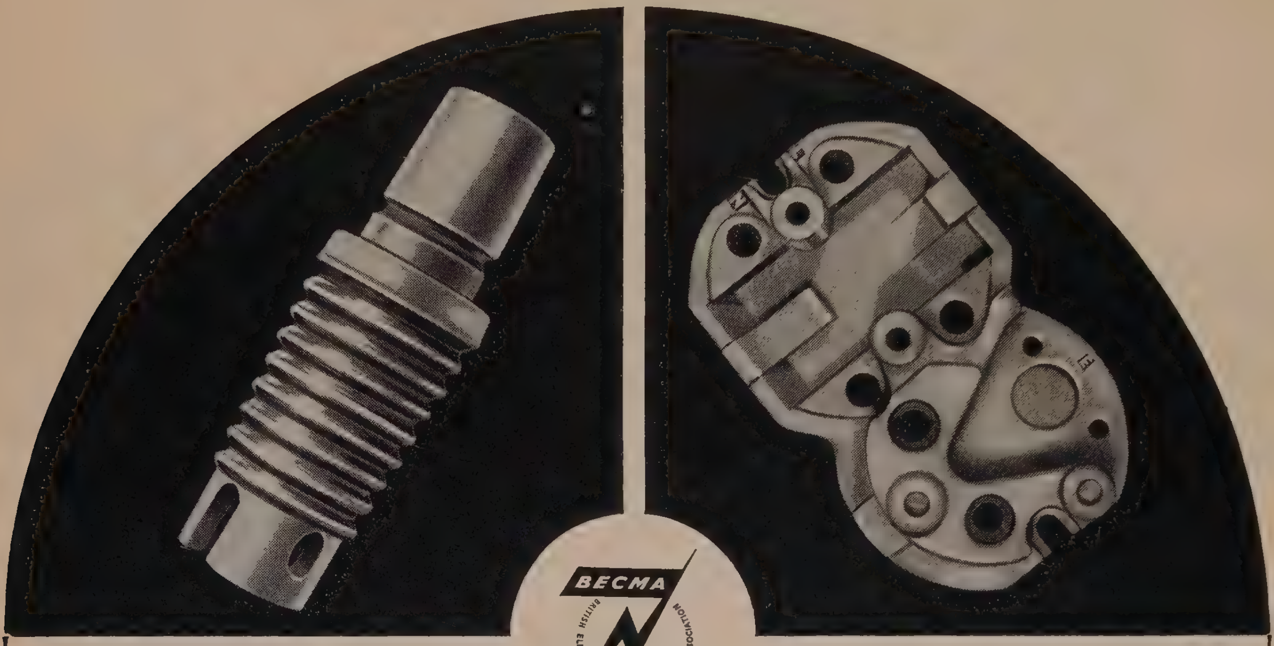
FENTON BYRN & COMPANY LIMITED

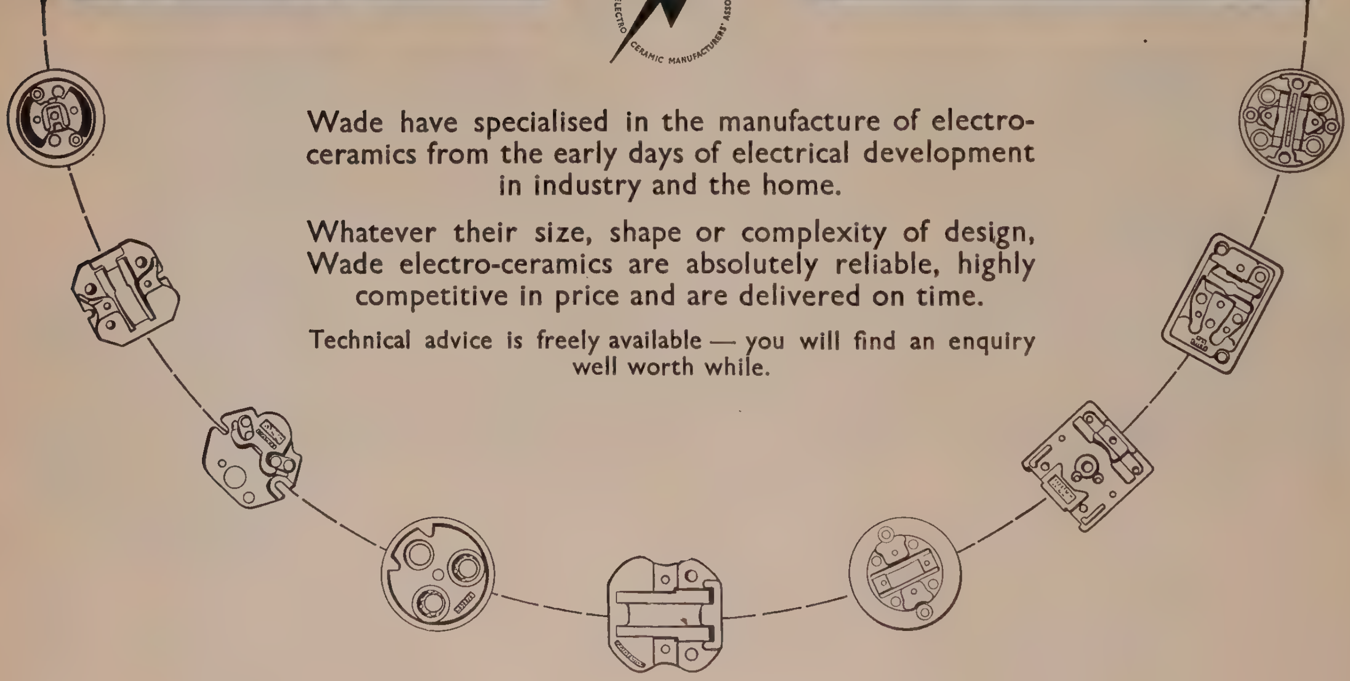
AIR-FLOW WORKS - BERRYLANDS - SURBITON - SURREY Phone ELMbridge 6724 (5 lines) Cables AIRLATION SURBITON Grams AIRLATION SURBITON

P.3202

WADE

ELECTRO-CERAMICS





Wade have specialised in the manufacture of electro-ceramics from the early days of electrical development in industry and the home.

Whatever their size, shape or complexity of design, Wade electro-ceramics are absolutely reliable, highly competitive in price and are delivered on time.

Technical advice is freely available — you will find an enquiry well worth while.

PORCELAIN FOR INSULATION.....WADE FOR PORCELAIN

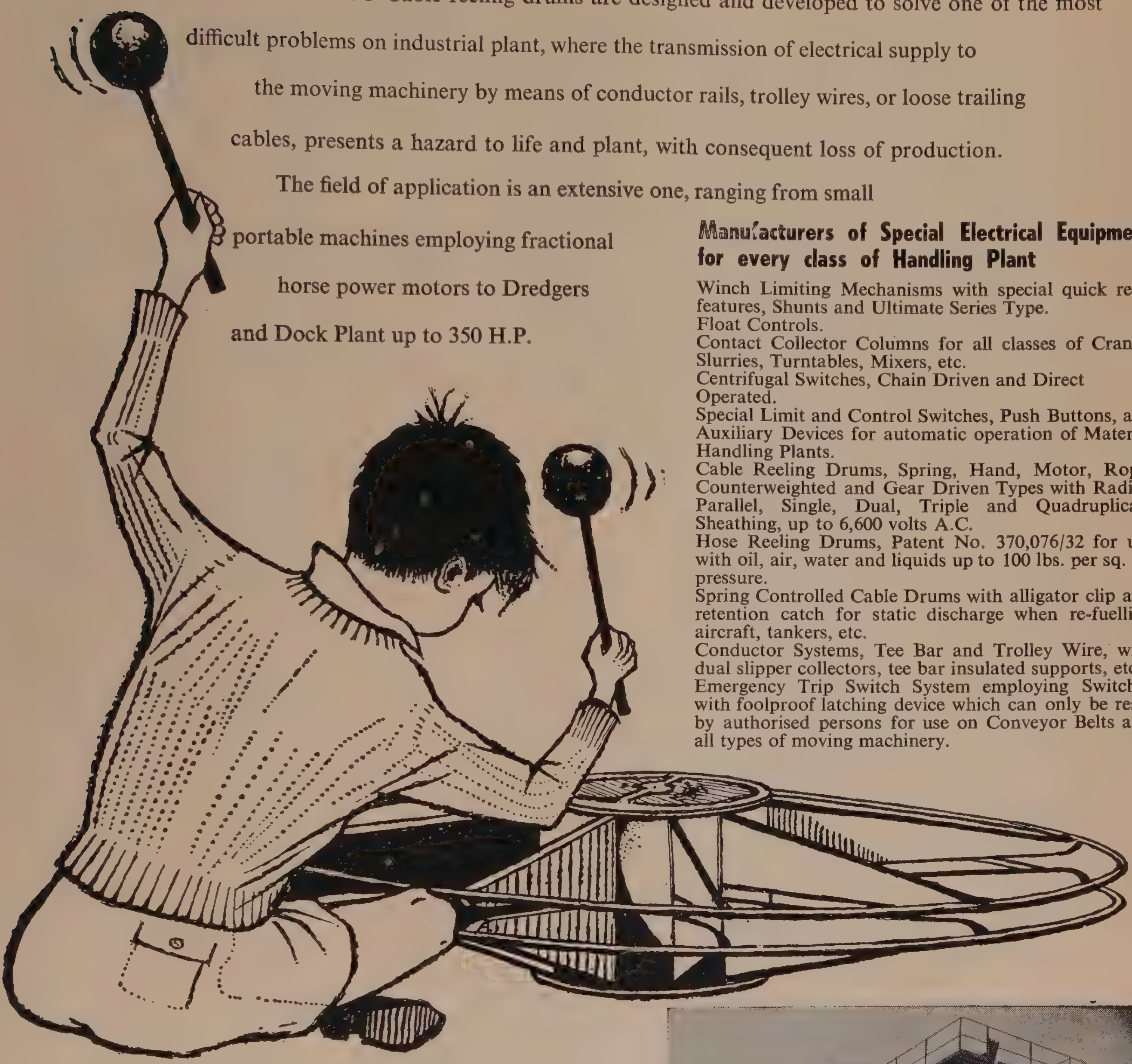
GEORGE WADE & SON LTD., BURSLEM, STOKE-ON-TRENT
WADE (ULSTER) LTD., PORTADOWN, NORTHERN IRELAND

Members of the WADE Group of Potteries

you can't beat this drum

DECO Cable reeling drums are designed and developed to solve one of the most difficult problems on industrial plant, where the transmission of electrical supply to the moving machinery by means of conductor rails, trolley wires, or loose trailing cables, presents a hazard to life and plant, with consequent loss of production.

The field of application is an extensive one, ranging from small portable machines employing fractional horse power motors to Dredgers and Dock Plant up to 350 H.P.



Manufacturers of Special Electrical Equipment for every class of Handling Plant

Winch Limiting Mechanisms with special quick reset features, Shunts and Ultimate Series Type.
Float Controls.
Contact Collector Columns for all classes of Cranes, Slurries, Turntables, Mixers, etc.
Centrifugal Switches, Chain Driven and Direct Operated.
Special Limit and Control Switches, Push Buttons, and Auxiliary Devices for automatic operation of Material Handling Plants.
Cable Reeling Drums, Spring, Hand, Motor, Rope, Counterweighted and Gear Driven Types with Radial, Parallel, Single, Dual, Triple and Quadruplicate Sheathing, up to 6,600 volts A.C.
Hose Reeling Drums, Patent No. 370,076/32 for use with oil, air, water and liquids up to 100 lbs. per sq. in. pressure.
Spring Controlled Cable Drums with alligator clip and retention catch for static discharge when re-fuelling aircraft, tankers, etc.
Conductor Systems, Tee Bar and Trolley Wire, with dual slipper collectors, tee bar insulated supports, etc.
Emergency Trip Switch System employing Switches with foolproof latching device which can only be reset by authorised persons for use on Conveyor Belts and all types of moving machinery.

ASSOCIATED COMPANY: **GRILL FLOORS LTD** manufacturers of: Grill Floors for Platforms and Mezzanine Floors, Steel Lattice Ladders, Patented Hand Railing, Grills for Coal Screens, Access Ladders with Convex Visible Edge Stairtreads, Window Cleaning Galleries, Trench Gratings, Duckboards, Servo Docks, Vehicle Washes, Scaffold Boards.

An illustration of a counter-weight operated radial reeling drum accommodating 130 feet of 4-core 1.3" overall diameter reinforced trailing cable for a 40-ton Goliath crane. (Photograph by kind permission of Messrs. Stothert & Pitt Ltd.)

DECO

TRADE DECO MARK
REGD.

cable reeling drums

DECO ENGINEERING CO. LTD., LONDON, W.10 **Tel: Ladbroke 3066/7** **Grams: Etyladec Wesphone London**

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Yes! trust a MACLAREN to be foremost! Seriously speaking, manufacturers do. That's why 95% of all leading manufacturers of Immersion Heaters and Thermal Storage Water Heaters have dependable, long-lasting MACLAREN MB Thermostats installed as standard equipment. When it's new, or when it's time to renew, specify the thermostat you can trust—it's a MACLAREN!

"MACLAREN"
ELECTRIC THERMOSTATS

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MOTORS
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WE MANUFACTURE
A.C. MOTORS ½ - 350 B.H.P.
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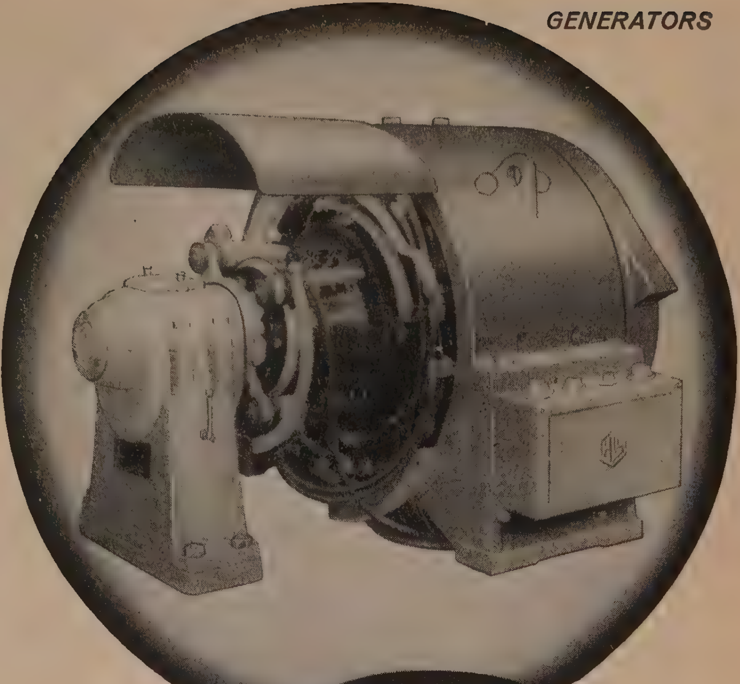
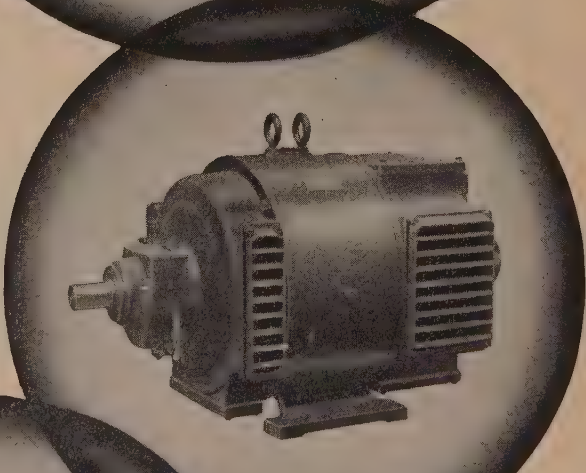
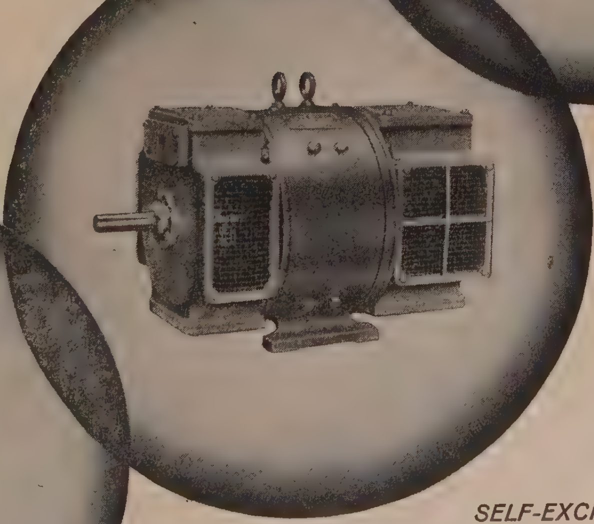
ALTERNATORS ½ - 125 K.V.A.
MOTOR GENERATOR SETS
GENERATORS ½ - 150 K.W.
INVERTED ROTARY CONVERTERS
MARINE MOTORS
WARD LEONARD SETS
FAN MOTORS
ETC.



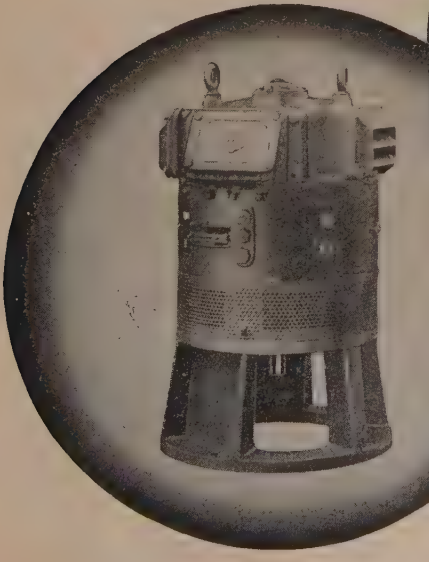
GENERATORS



D.P. OIL RING MOTORS



SELF-EXCITED ALTERNATORS



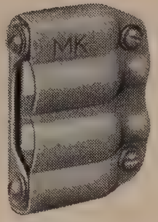
VERTICAL SKIRT MOTORS

HUGH J. SCOTT H.J.S.
VOLT WORKS, BELFAST, N. IRELAND

MK BOXES AND CLAMPS FOR M.I.C.C. CABLE

CABLE CLAMPS

Cable clamps are suitable for single or twin-core mineral insulated copper covered cable 0.0015 to 0.003 cross-sectional area.



List No. 901—single entry cable clamp.

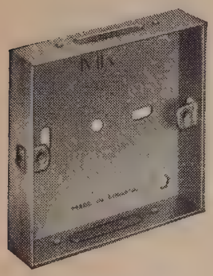
List No. 902—double entry cable clamp.

MK have introduced a new range of boxes and clamps for MICC cable. Single or double entry clamps are interchangeable with any of the boxes and are supplied separately with fixing screws and shakeproof washers. Steel boxes and cable clamps are zinc plated.

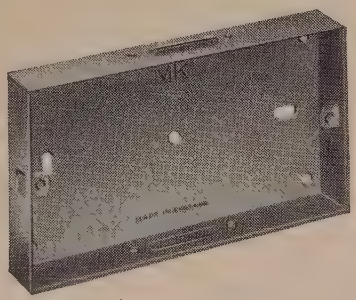
WRITE FOR LEAFLET 257

PLASTER-DEPTH BOXES FOR M.I.C.C. CABLE

These boxes have one clear entry and one knockout for attaching either single or double entry cable clamps.



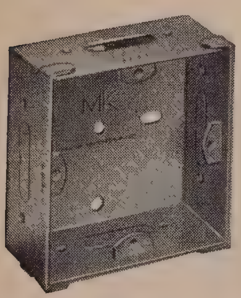
List No. 3951—Plaster-depth box with 2⅜″ fixing centres.



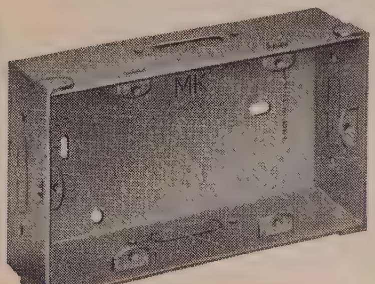
List No. 3952—Plaster-depth box with 4¾″ fixing centres.

DEEP BOXES FOR M.I.C.C. CABLE

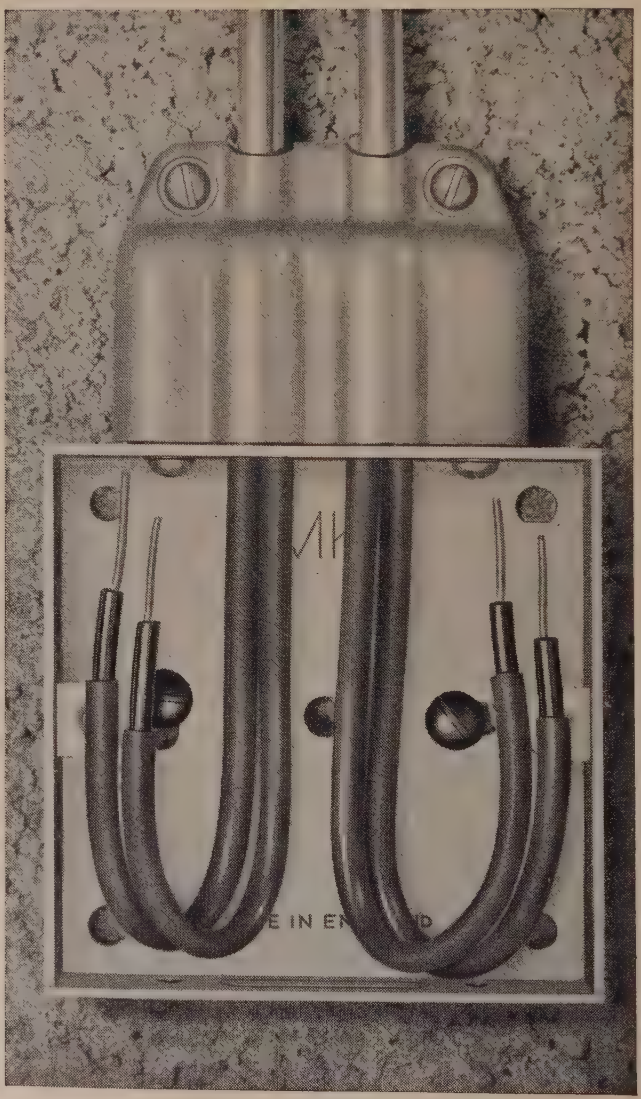
Deep boxes have one clear entry on one side and one knockout on each of the other three sides and one in the back to which can be attached a single or double entry cable clamp.



List No. 881—Box to BS 1299/1363 dimensions having 2⅜″ fixing centres.

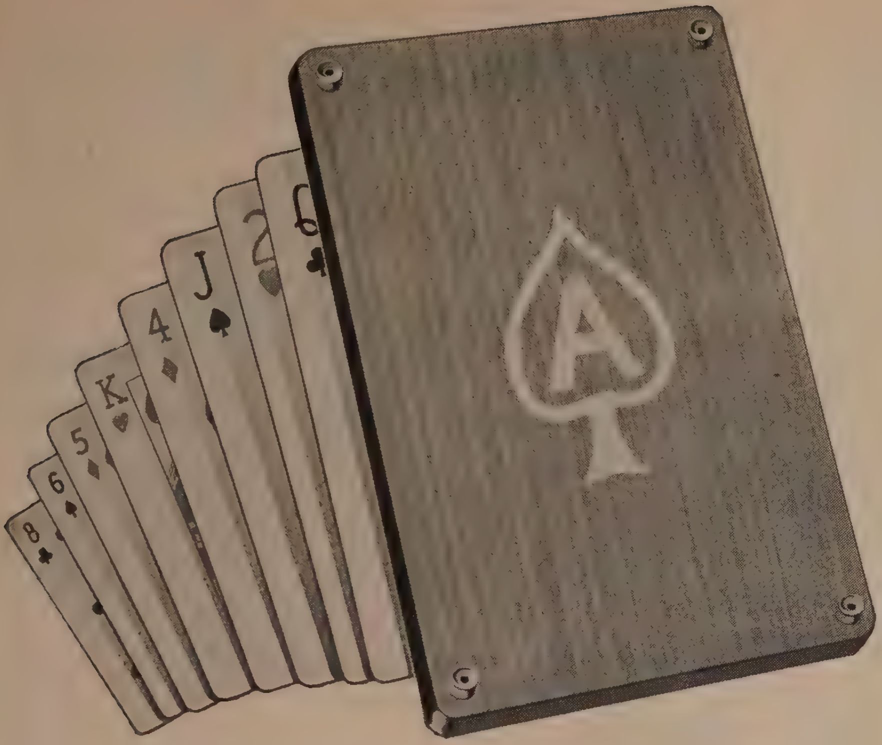


List No. 882—Box to accommodate any two gang MK accessory.



M.K. ELECTRIC LIMITED, SHRUBBERY ROAD, LONDON, N.9. EDMONTON 5151

MK197DHB

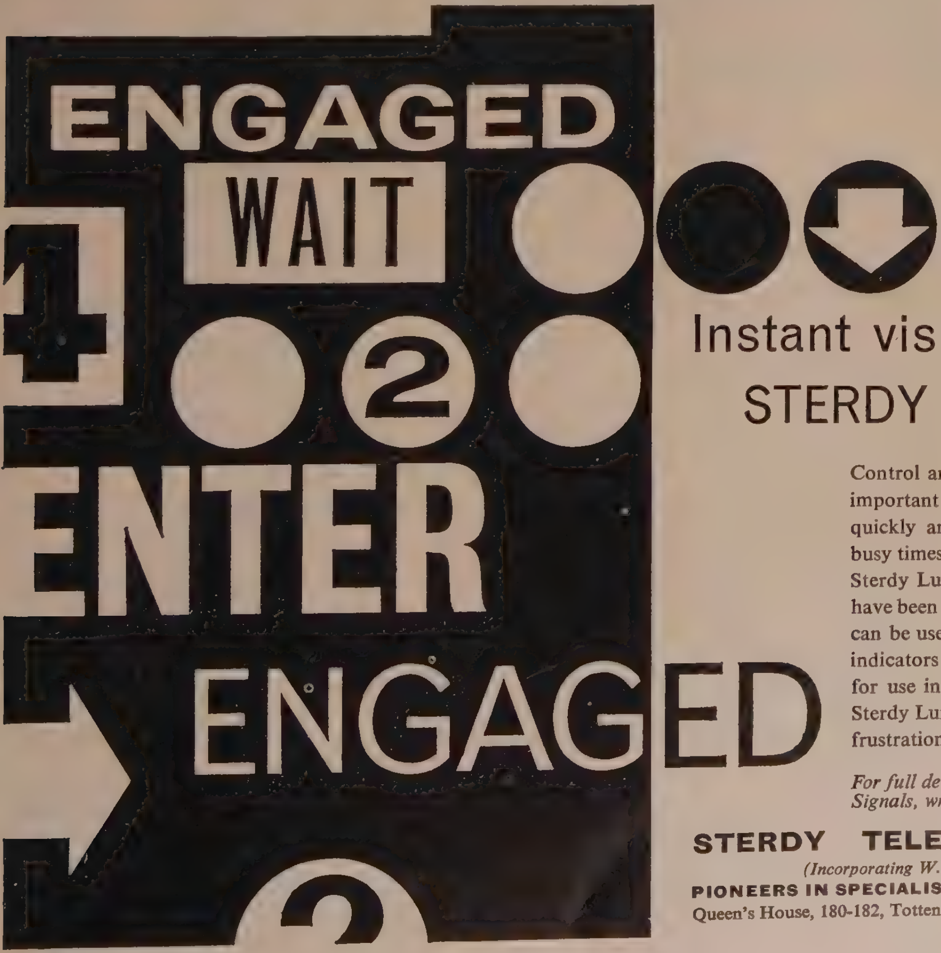


Wootton meter boards are Trumps !

Naturally . . . when they're Wootton-made . . . and Wootton-tested! They're made of the best plywood Wootton could lay hands on. Tested for reliability . . . toughness . . . durability. Wootton meter boards stand up to anything. Even in the most extreme climates. No contraction or expansion or warping with Wootton! Oh, and there's more to Wootton than just meter boards. They make wood blocks too, and instrument cases, and they're aces at sunk switch boxes.

WOOTTON-the meter board people

WOOTTON & CO. LTD
ALMA WORKS · PONDERS END · MIDDX
Telephone: HOWard 1858



Instant visual contact

STERDY luminous signals

Control and communications are playing an increasingly important part in business life, the ability to contact staff quickly and unobtrusively is a golden virtue in these busy times.

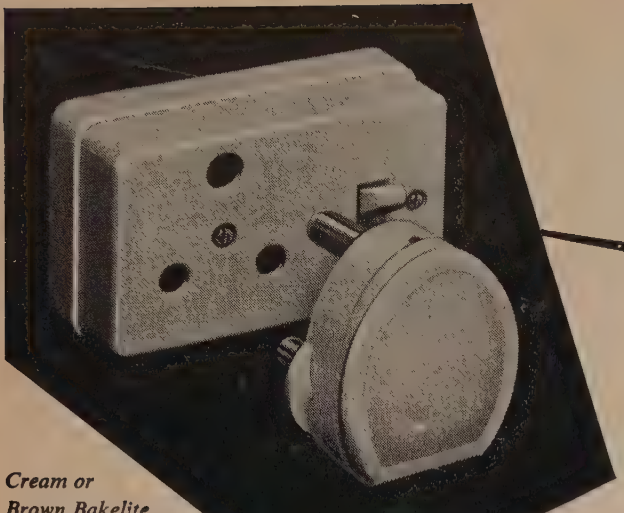
Sterdy Luminous Signals in a variety of different forms have been developed to oil the wheels of commerce. They can be used for staff location, as Engaged—Enter—Wait indicators on executive's doors and as lift signals. Ideal for use in Hospitals, Factories and Offices of all sizes, Sterdy Luminous Signals can banish business worries and frustrations—by improved visual communications.

For full details of Sterdy Luminous Signals, write to:

STERDY TELEPHONES LTD
(Incorporating W. C. Davey & Co.)
PIONEERS IN SPECIALISED COMMUNICATIONS
Queen's House, 180-182, Tottenham Court Road, London, W.1
Telephone: MUSeum 4414, 4415 and 6388

EST. 1920 STERDY TRADE MARK

AP 83



CONTACTUM

Surface Switched Socket-Outlets

2, 5 and 15 amp. A.C.

Cream or Brown Bakelite

MANY years' experience of switch designing and manufacture are behind these latest additions to the Contactum range. *Specification:* Slow break type action with silver-inlay contacts and large brass terminals. Sprung brass socket tubes spring-reinforced. Well recessed. Conforms to B.S. Specifications wherever these can be applied.

Easy to install
●
Single and Double Pole
●
Complete with Plugs
●
Shuttered
●
All-insulated
●
250 volts

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New developments in Rotork valve control

Valve manufacturers and users all over the world have helped Rotork develop their new series of electric actuators—the 'A' range. Such practical advice, coupled with Rotork's comprehensive experience of valve control, ensures that the 'A' range offers the most competent method available for automatically controlling any size or type of valve from any distance.

An entirely new manufacturing and selling organisation has been created to keep pace with the growing international demand for Rotork actuators. Highly competitive prices and good deliveries on a world-wide scale are assured by the overseas manufacturing and sales facilities now available in West Germany, France and Italy to augment U.K. production; as well as offices or agents in Holland, Switzerland, Australia, Canada and the Arabian Gulf.

A booklet covering every aspect of the Rotork 'A' range of actuators is available on request.

Outstanding features of the Top Handwheel 'A' Type Actuator illustrated are:—

Motor:
Squirrel cage, Stator/rotor unit, half hour rated and built to BSS 2613. Available with class 'A', 'B' or 'E' insulation.

Input Shaft:
Motor, worm and torque measuring spring pack are all on this common shaft, which slides in direct proportion to the torque transmitted to operate the torque switch to shut off the motor.

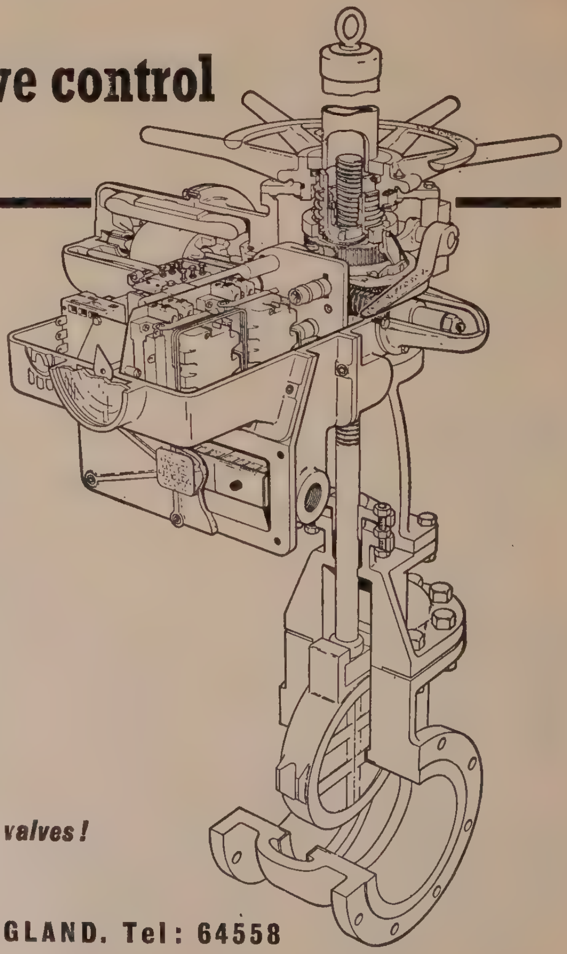
Housing:
All components taking the thrust load are housed in the base of the actuator. Those fixed directly to the valve are indestructible within the requirements of BSS 1414.

Enclosure of Electrical Equipment:
Weatherproof actuators are available, flameproof, non-flameproof, with Buxton certified motor and electrical compartments.

Geared Limit Switches:
Accurate and efficient, operated directly from the output shaft, the switches can be independently adjusted to operate at any point during valve travel.

Torque Limit Switches:
The torque switch is held closed by a coil spring and released when the pre-set torque output is reached; a set screw adjusts the tripping point.

Built-in Starter:
The integral starter illustrated is of Brookhirst Igranic block type 620, reversing contactor



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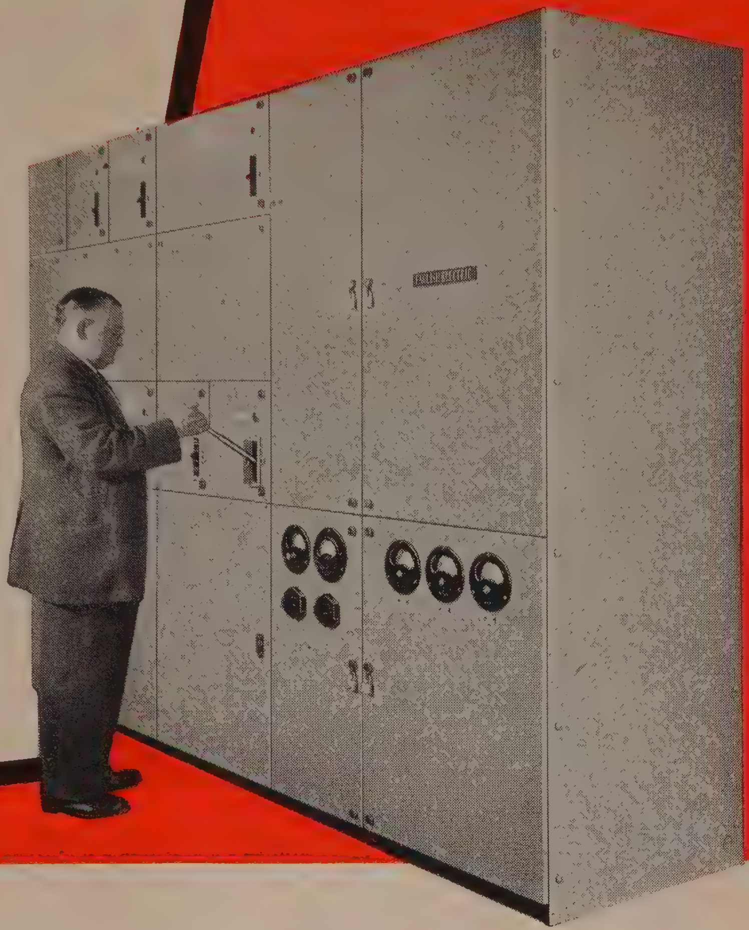

THE BASIC ADVANTAGES OF THIS NEW DESIGN ARE—

★ Compact arrangement with economy of space
★ Saving in building costs
★ Saving in installation costs
★ Attractive appearance of the installation

Plus

The latest exclusive technical features of 'English Electric' 'Superform' Switchboards and Open Type Substation Distribution Equipment.

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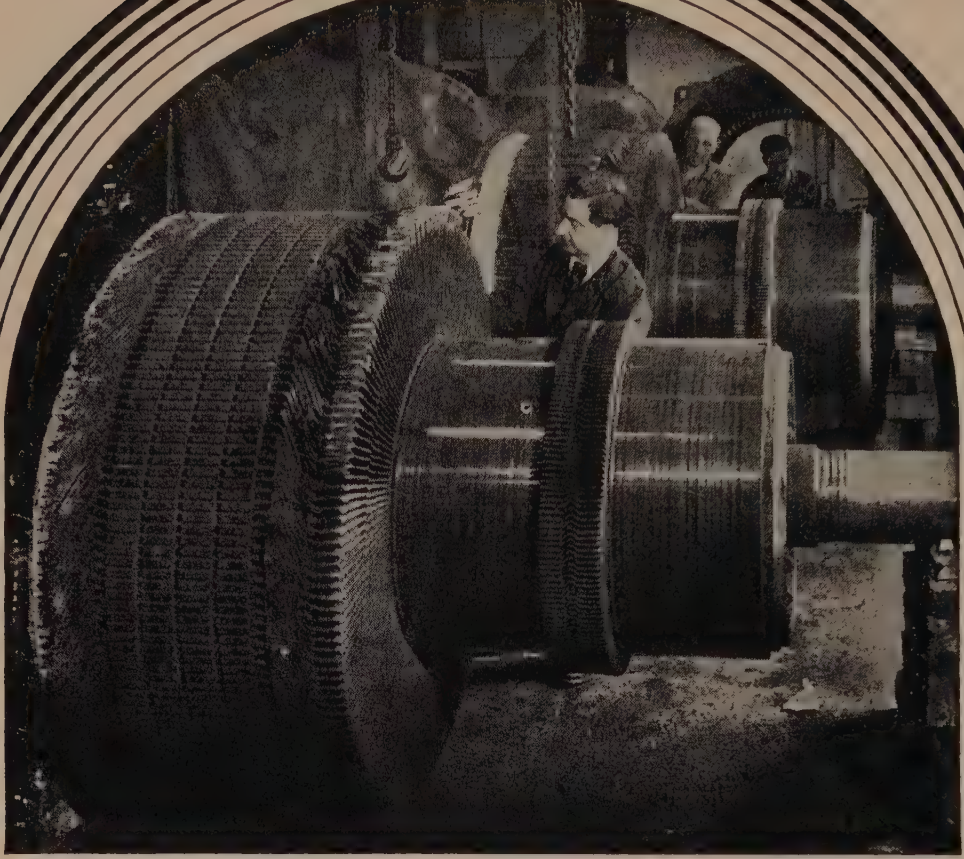

Engineers' Language! For every Plant Engineer who swears at Collins, there are ninety-eight and a quarter who swear by them. Engineers being engineers, this is quite something. As we were saying, we show two 1500kW 240-volt 600 r.p.m. D.C. Generators, one being stripped out for rewinding, t'other being rewound.

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The Ferranti 'FMmMD' and 'FMMD' maximum demand meters register the maximum demand of a singlephase circuit, and consist of a singlephase meter element of the 'FMm' or 'FM' type respectively combined with a maximum demand indicator of the Merz type. Both these meters can be supplied with a self-contained synchronous timing unit or alternatively can be made suitable for use with a separate time switch. For the latter the resetting mechanism may be either of the "normally closed type" or "normally open type."
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FM 131/2

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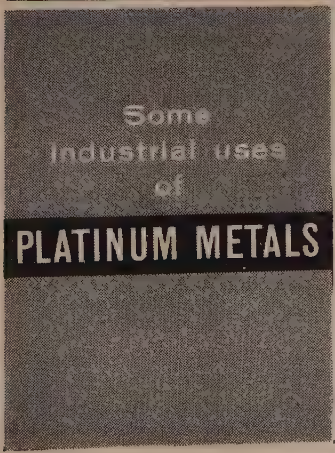

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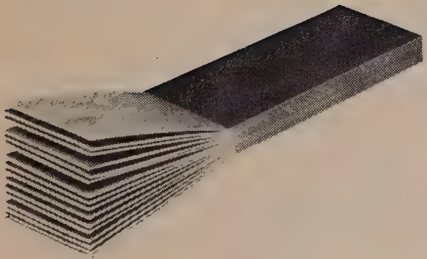

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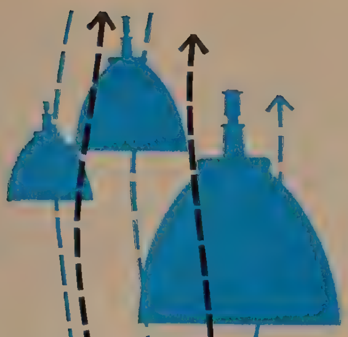
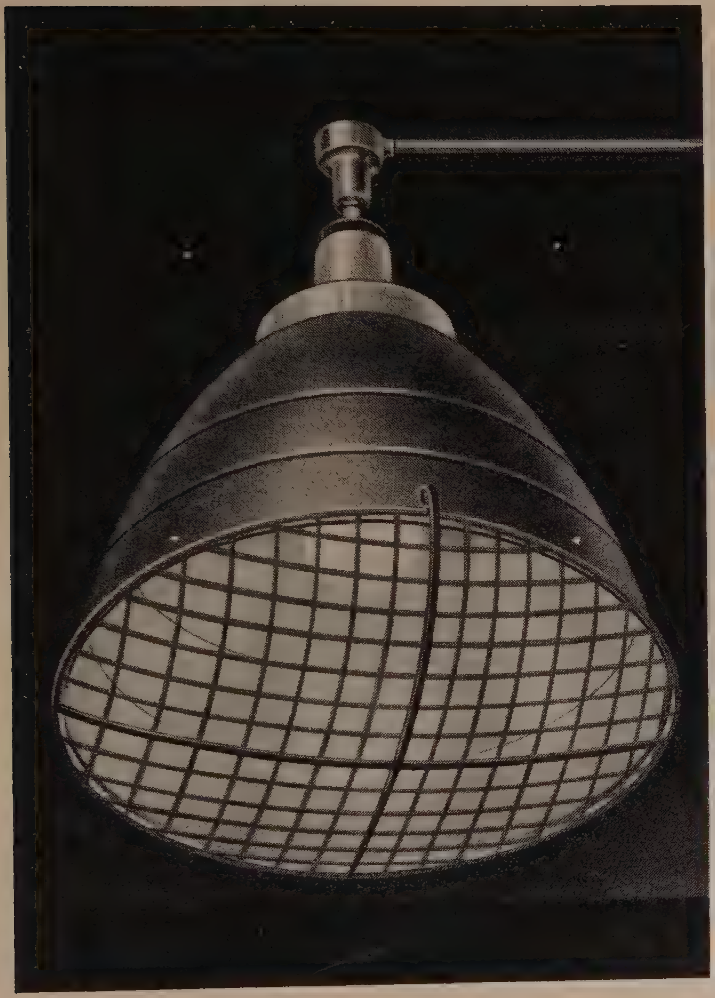


new self-cleaning high bay lighting



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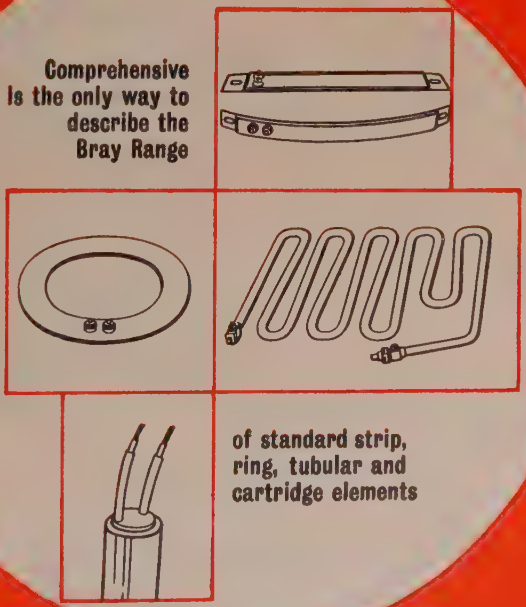

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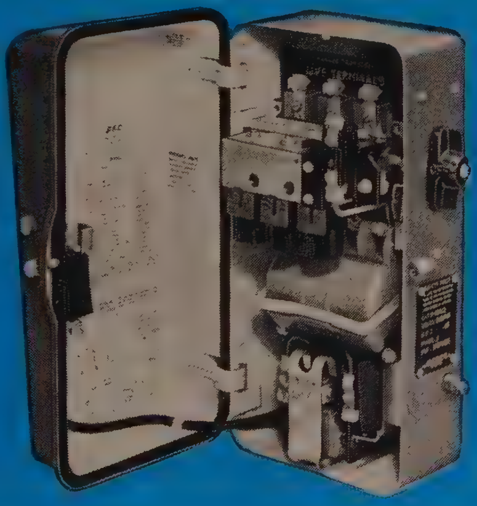

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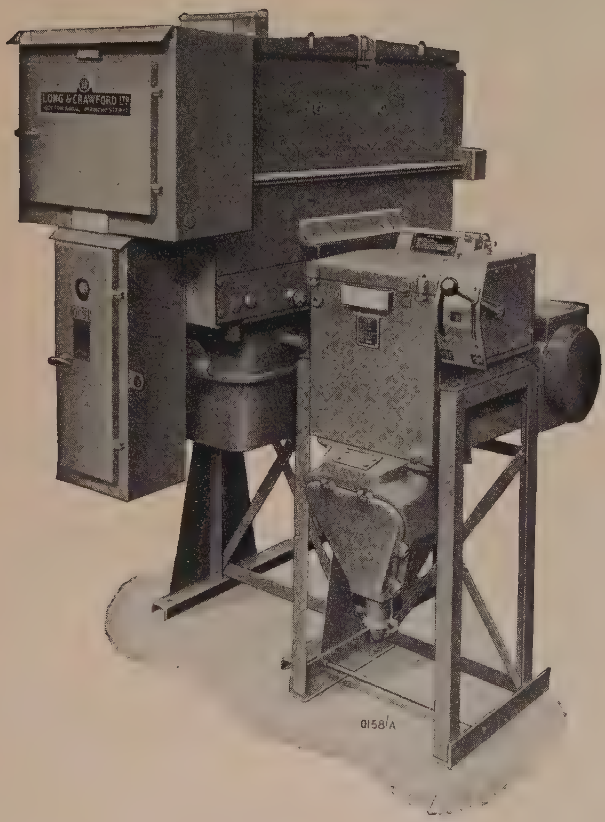
OUTDOOR
CIRCUIT BREAKERS



Off load oil isolators on both sides of Breaker.

Earthing of circuit through the Breaker. (Also bus-bar earthing if required.)
Full safety interlocks to prevent maloperation.

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Built to line up with existing outdoor oil switches, etc.

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Breaking Capacity Rating—250 MVA at 6·6 kV and 11 kV.

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6.6 kV to 11 kV
250 MVA

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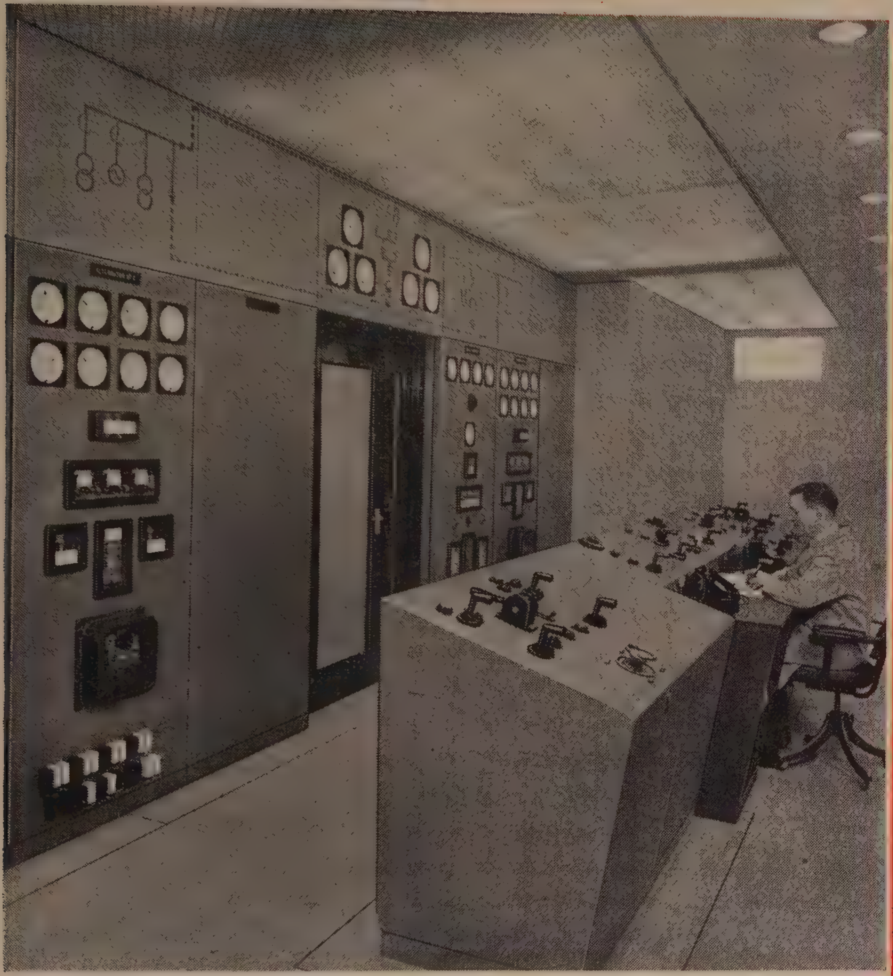

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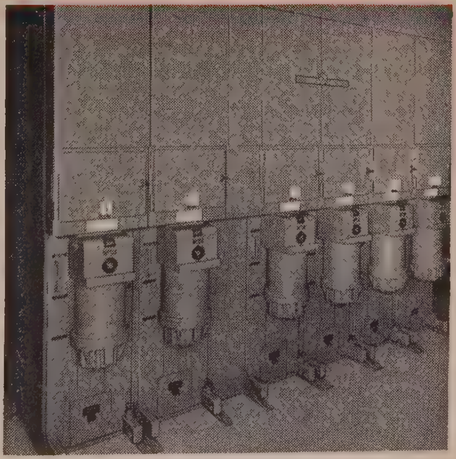
This contract is typical of many carried out by S.W.S. Ltd. for the supply of switchgear, transformers and associated equipment to all branches of industry.



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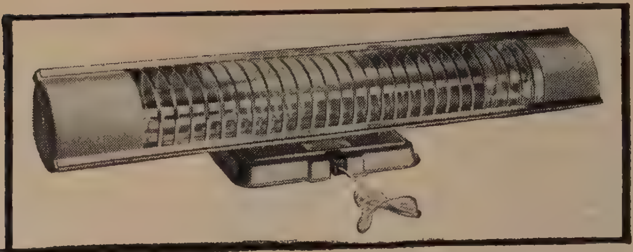

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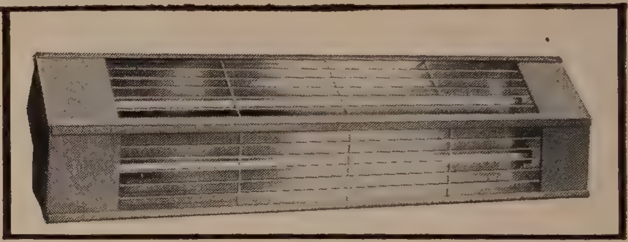

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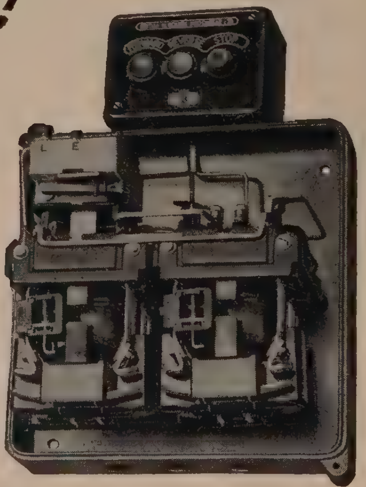
Oil Immersed Models have copper contacts.
Illustrated is starter with built-on push button station suitable for squirrel cage motors up to 7½ h.p. Heavy duty starters available for controlling motors up to 30 h.p.



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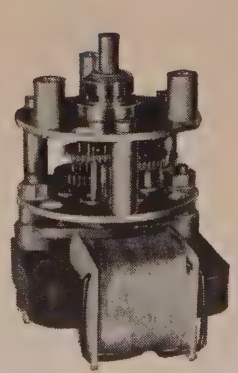

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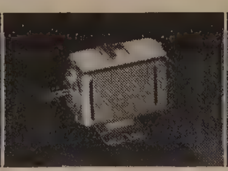
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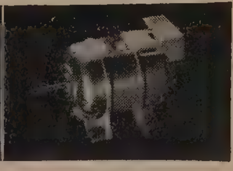
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Capacitor
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Speed
20-700 RPM

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Constant
Speed
20-700 RPM

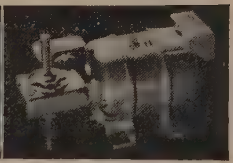
Shaded Pole
Constant
Speed
1/4-18 RPM

Series Wound
Variable
Speed
0·5-60 RPM

Series Wound
Variable
Speed
0·3-60 RPM

Capacitor
Constant
Speed
0·3-19·5 RPM

Capacitor
Constant
Speed
0·2-19 RPM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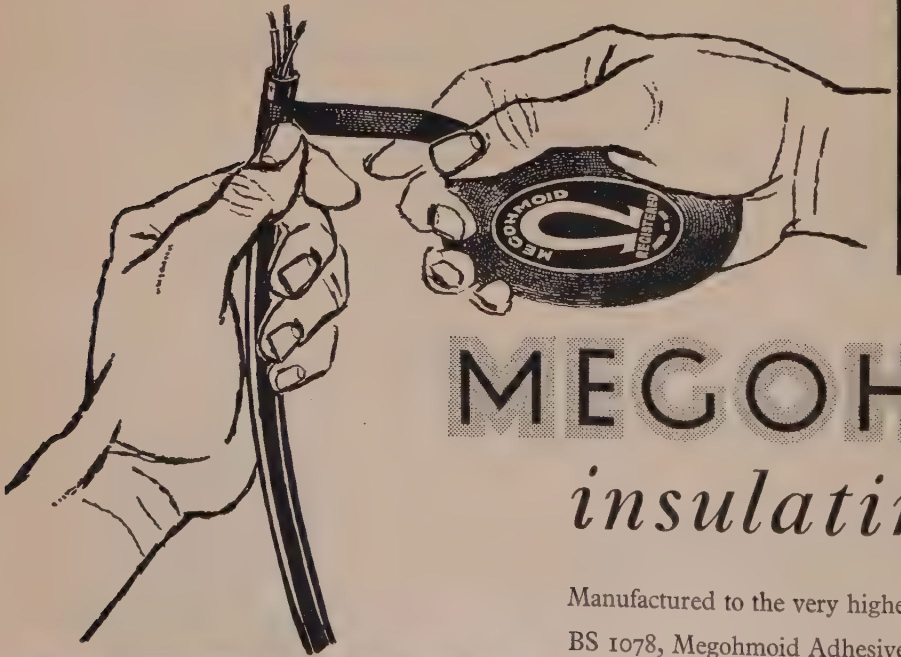

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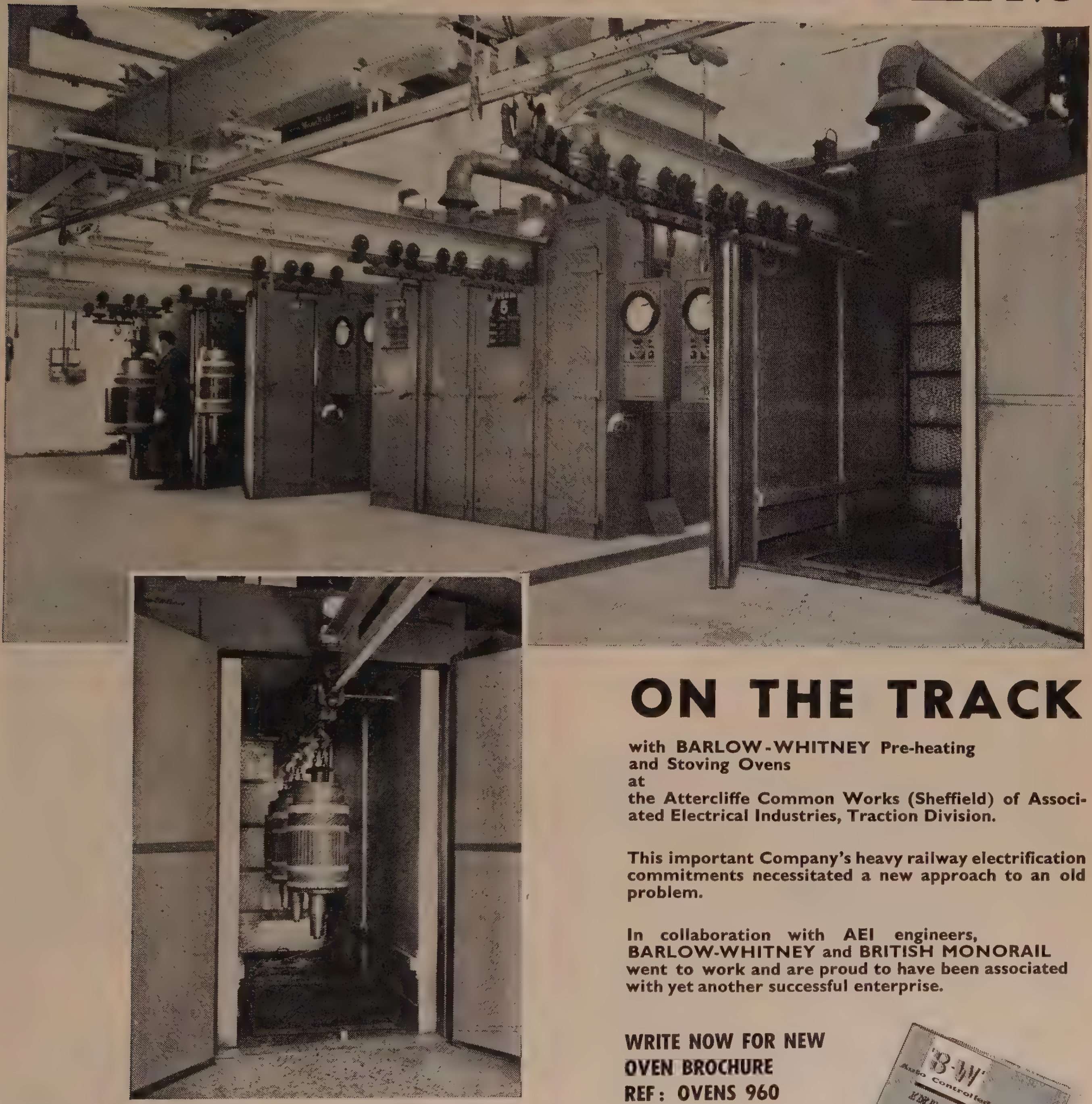

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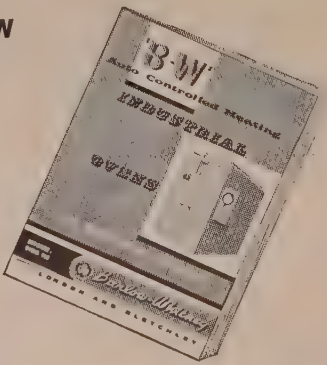

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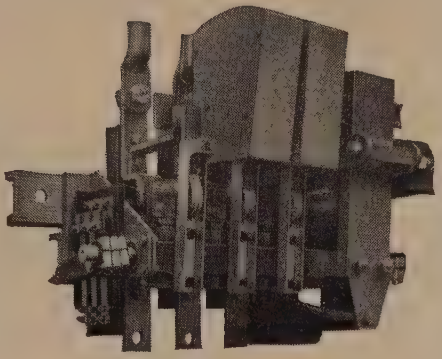

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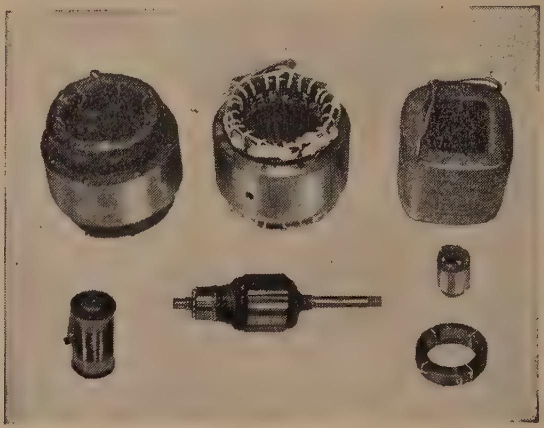

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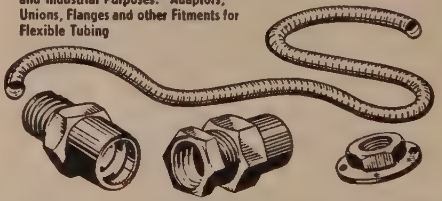

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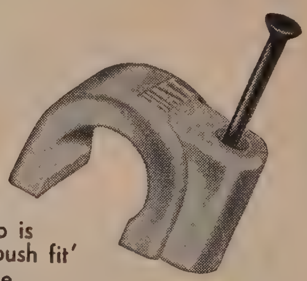

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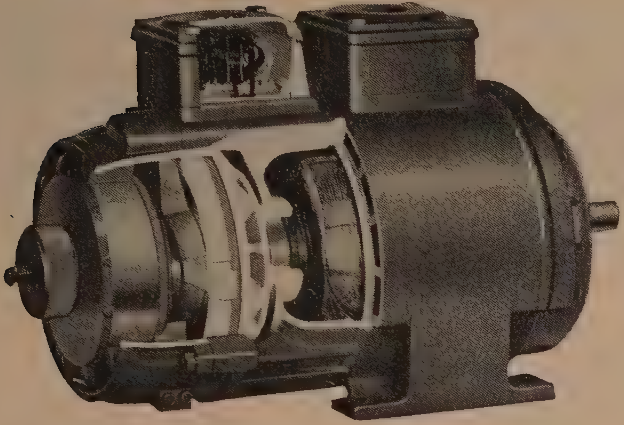

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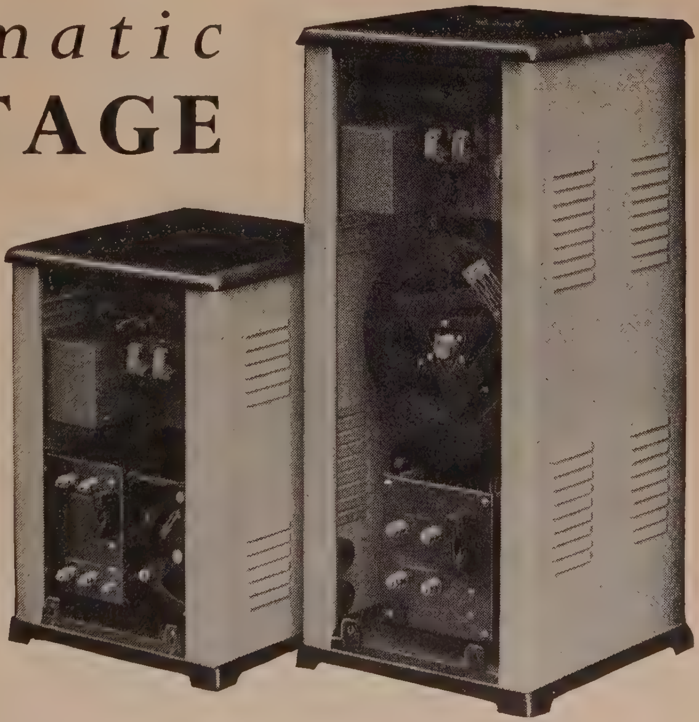

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30 DECEMBER
1960

ELECTRICAL REVIEW

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Contact Materials	1139	In this article an approximate relationship is suggested for grading contact materials according to their resistance to erosion

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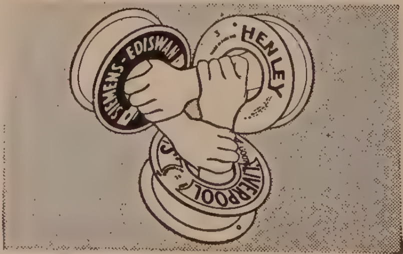


ELECTRICAL REVIEW

30 December 1960 Vol. 167 No. 27 Established 1872

Small Beginnings

SIDE by side with rapid developments in electricity generation and distribution, increasing attention is now being paid at home and abroad to possibilities latent in the application of scientific principles not yet commercially exploited. At present, these generally yield too small an output to contribute significantly to the total kWh produced, but some of them offer promise of supplementing the scope of orthodox methods and expanding the field of utilisation of electrical apparatus.

Thus one branch of research aims at avoiding the waste of nearly two-thirds of the heat energy of fuel (in even the best instances) by sidestepping the inherent limitations of the Carnot steam cycle. This ideal is exemplified in the direct conversion of heat energy into electricity, without the intervention of boilers and turbines, by means of the fuel cell; an efficiency of about 98 per cent has been claimed for experimental units of 5 kW or so. Another way is indicated in the magneto-hydrodynamic system, in which electricity is generated by inserting electrodes in a flow of gases passing across a magnetic field. Further exploration of practical uses of Seebach and Peltier effects relating to electrical potential differences generated at the junction of conductors of dissimilar metals is also being undertaken. A refrigerator employing the Peltier effect has already been developed.

Among other items of work in hand are attempts to harness a bigger proportion of natural resources—not on account of the fears at one time often expressed about their possible exhaustion in any foreseeable future, but because of their economic advantages in specific cases and the not infrequent chance of by-issues of research leading to discoveries of far-reaching importance.

Prominent among present investigations are attempts to harness more than a barely appreciable proportion of the radiant energy received from the sun, wind power, radioactivity and volcanic heat of the earth itself and the electro-dialysis cell for treatment of brackish water. Development costs may be high and may sometimes entail some means of storage, but maturity, even though long delayed, has very often directly or indirectly yielded worth-while dividends.

An encouraging analogy may be drawn from the history of electricity supply during the last half century, from the time when a plant of a few hundred kilowatts served the needs of quite sizeable towns to the conditions of today when ratings are assigned in hundreds of megawatts. This advance has been continuously accompanied by the introduction of multitudinous small electrical appliances which have come to be regarded as amenities requisite to civilised living and which through their diversity have raised the general load factor with consequently lower costs to the public. Not the least of the benefits conferred by light-current engineering applications is in automatic or semi-automatic control of heavy generating plant and machinery as referred to in our leading article of 9th December. A social feature implicit in such trends is the freeing of men from arduous manual labour to perform tasks that provide greater opportunities for the exercise of mental capability of a higher grade.

PRECAUTIONARY MEASURES

There have already been warnings of possible power cuts this winter. With the normal rate of increase in consumption and not too severe weather the Central Electricity Generating Board would have had ample plant to meet the demand. But recently the pace of electricity sales has quickened and we do not yet know what climatic conditions are ahead. Moreover it is not only generating plant which may be strained; too many distribution systems are already loaded to their limits.

Consequently endeavours should be made immediately to prepare for possible trouble. Consumers' confidence in electricity must not be sapped by panic measures but they should be told that they can prevent cuts by avoiding excessive use of electricity during peak hours. In the Midlands industrial concerns have been warned that in exceptionally cold weather, particularly in January, it may be necessary to shed load. A rota has been prepared to ensure equitable emergency treatment. Each consumer concerned will be asked to be ready to cut his demand on a fixed day each week and for not more than half an hour. It is to be hoped that these measures will not have to be resorted to but it is well to have an orderly arrangement of this kind ready in case of necessity.

LARGE HYDRO-ELECTRIC WORKS

The development of the world's hydro-electric resources is still proceeding on a grand scale and evidence of this is provided by two recent events abroad. In Russia the 2,415 MW Stalingrad hydro station on the Volga has been completed with the commissioning of the twenty-first turbine—a 115 MW unit. This plant can provide 14,000 million kWh per annum. In France the first two of an ultimate six 113,000 h.p. units have started turning over at La Bathie hydro station in Haute-Savoie, which is fed by the Roselend dam. This dam, the crest of which is 2,640ft long and 495ft high, was designed by André Coyne (who was also responsible for the Kariba Dam) and is unique since it is both an arch dam and a buttress dam.

At Roselend a 1¼ sq mile lake holding 6,600 cu ft of water has been created at an altitude of over 5,000ft. The station is underground and when completed will be capable of generating 1,000 million kWh per annum. On demand, it will be able to inject 500 MW of electrical energy into the national network in only three-and-a-half minutes. Of course, it can be seen from the above figures that the French plant has a load factor of only about 16 per cent whereas the Russian run-of-river plant operates at 66 per cent.

PURCHASE TAX CONCESSION

At the moment the effect of the removal of purchase tax from certain forms of domestic electric central heating (see page 1142) cannot be regarded as very great. The principal beneficiary will be the domestic electrode boiler produced by leading makers of this type of equipment, mostly for commercial and industrial use. Indeed we believe that the Treasury was influenced in its decision by representations from these manufacturers who felt that their product was unfairly handicapped in relation to gas and solid fuel systems.

Other forms of domestic electric central heating which benefit from the concession are hot air generators associated with duct systems, in which the heat pump may be included. The principal form of electric central heating (if the term can be applied here) is floor warming which, of course, is not subject to purchase tax.

EXPORT PROSPECTS BRIGHTER

The main point of danger in the British economy is still insufficient export earnings. With world trade less buoyant and costs tending to creep up again the task of increasing exports is doubly difficult. Looking at the disappointing trade figures this year, the failure of production to expand after the second quarter and the new rise in engineering wages, it would not be unreasonable to view the immediate future pessimistically. But there have been several indications to show that this would be wrong.

Domestic appliance manufacturers are tackling the problem of exports energetically and with some success. At present this effort is confined to too few firms, not all large, but the difficulties of the past year may persuade others that greater export sales could provide a cushion against inevitable fluctuations in home demand. Lord Chandos has said significantly of his own company that they have decided that exports are of sufficient importance not to be regarded as an offshoot of the home business.

On the capital goods side production has been expanding and the rise in investment and export orders is a hopeful sign that this will be continued into 1961. A high level of investment in manufacturing industry is an essential condition of the further development of overseas business, and it is therefore particularly encouraging to learn from a survey undertaken in November by the National Institute of Economic and Social Research that private industry's plans for expanding investment have not been affected by the credit restrictions.

BELVEDERE

OIL-FIRED 480 MW GENERATING STATION

When completed next year, this oil-fired 480 MW station will have four 60 and two 120 MW turbo-generator/boiler units. Originally intended to be equipped with eight 60 MW units, the station has undergone a number of design changes including a transition from coal to low flash oil and now to heavy oil for fuel, with provision for the adoption of coal firing later if required. The boilers have been supplied by John Brown Land Boilers, Ltd., and the turbo-generators are of English Electric manufacture

ALL of the four 60 MW turbo-generator/boiler units installed at the Belvedere, Kent, generating station of the London Division of the Central Electricity Generating Board are now in commercial operation, the first being commissioned in May last year, some 4½ years after work was started on the site. Designed for an ultimate capacity of 480 MW, the station was originally to be equipped with eight such units, but following the rapid rise in the rating of individual generating units the second half was redesigned to accommodate two 120 MW sets. The first of these larger units has just been put into service and the station will be completed during next year, No. 6 being due for commissioning in April. The estimated cost of the station is £25 million, which is equivalent to some £52 per kW of installed plant capacity.

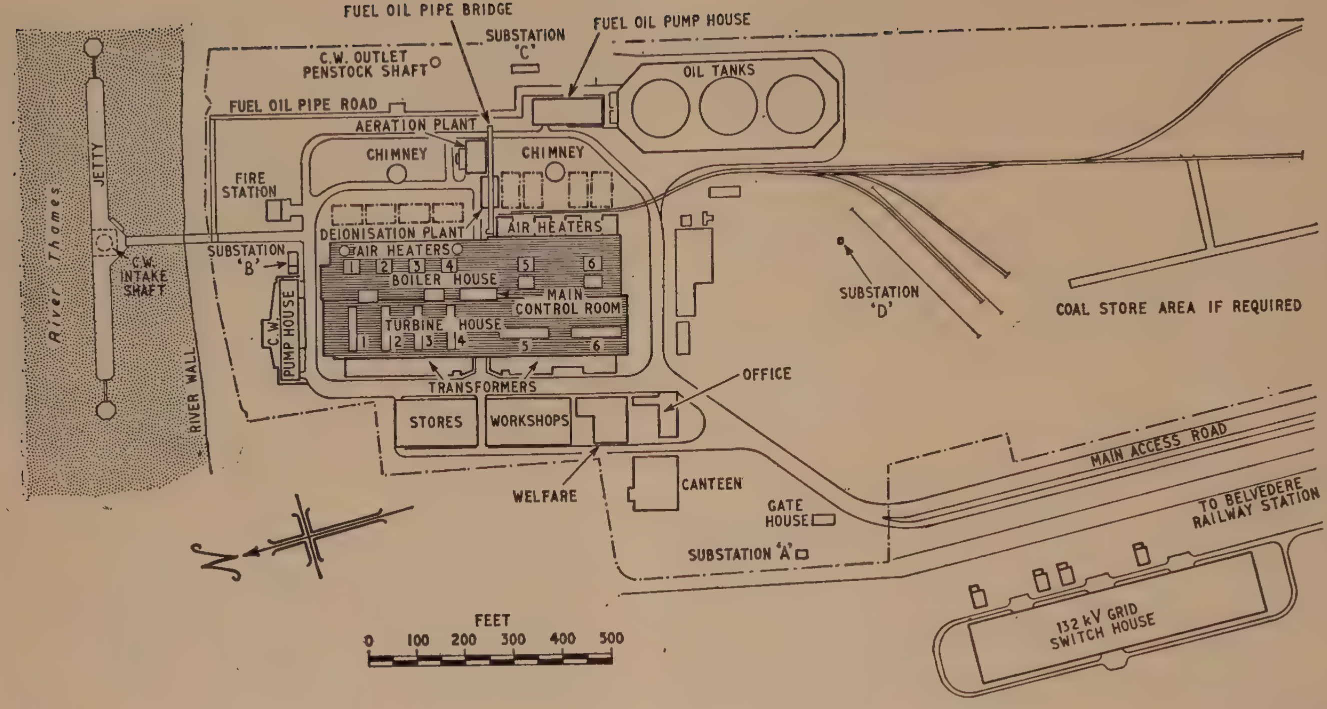
The station was originally designed to burn coal but due to changes in the nation's fuel policy the decision was made to adopt dual firing, first with oil only but with provision for the later introduction of coal if necessary. It was initially intended to burn low flash oil but this was later changed to the normal heavy fuel oil now used.

The station is situated on the south bank of the River Thames on a 52-acre site on Erith Marshes, originally the property of the West Kent Electric Co., Ltd., and directly opposite the Dagenham works of the Ford Motor Co. The site has an extensive river frontage amounting to some 255 yd, while the main access road leads to the A206 Woolwich–Erith Road, passing Belvedere railway station on the London Bridge to Dartford line from which a temporary spur has been taken giving direct rail access during construction.

The river is constrained along this reach by a 12ft high wall, the basement level in the first half of the station being some 4ft below mean high water level and that in the second half being about 2ft lower. During construction the ground water level was lowered by some 35ft to —30·00 O.D. to facilitate excavation.

The main building comprising the turbine hall and boiler house is of steel-frame construction with aluminium sheet cladding and patent glazing in all exterior walls at the operating floor level in addition to the roof monitors. The turbine hall on the west side of the building is 110ft wide and 96ft high and is equipped with two Stothert & Pitt cranes of 150 and 40 tons capacity. The boiler house

Right: A feature of the turbine hall, seen in this view showing the four 60 MW sets, is the window area at turbine floor level



Site plan of Belvedere generating station

at the Nos. 5 and 6 units end is 121ft wide and 165ft 10in high. The main station building, which is on " Wests " *in-situ* piling with reinforced concrete pile caps, is 592ft long and has a total volume of about 15½ million cu ft, representing some 32·3 cu ft/kW of installed capacity.

Behind the boiler house are the four Howden air heaters associated with the two boilers for the 120 MW units, the eight for the smaller units being installed in the boiler house. There is space for the installation at a later date of electrostatic precipitators which would be required should the station change to coal firing,. Two 420ft high reinforced concrete chimneys have an internal diameter of 18ft 6in at the top. In both chimneys the annular space between the reinforced concrete shell and the acid resisting brickwork lining is filled with vermiculite to reduce heat loss through the bricks and prevent the formation of acidic smuts.

There are no cooling towers, all the circulating water required being taken from the River Thames, but between the two chimneys is situated an aeration plant which was a requirement of the Port of London Authority's licence to use river water. This plant compensates for the reduction of oxygen in the river resulting from the increased activities of anaerobic bacteria in the river bed caused by the higher temperature of the discharged circulating water. The c.w. pumphouse is situated between the main building and the river wall while to the west of the main building are compounds for the generator and unit transformers and separate buildings for the administration offices, welfare offices, workshops, stores and main canteen. The southern half of the site, which was originally allocated for low flash oil storage tanks, oil pump house and a fire pump house has now been left clear for use as a coal store if required. The main switch house connecting the station with the 132 kV grid is in the south-west corner.

The station burns heavy fuel oil having an average calorific value of 18,050 B.Th.U./lb, the daily consumption being some 3,000 tons when the station is operating at 100 per cent load factor. The oil is delivered by tanker to the 630ft long river jetty which is of reinforced concrete construction and is built to carry coal unloaders and conveyors should they be required later. Access to the jetty is by a bridge, constructed to preserve the right-of-way along the river wall. At present the jetty has six 8in oil discharge connections arranged in three pairs. These are tied to two 12in mains which can each deliver oil at a rate of 500 tons per hour to the three 13,300 ton capacity storage tanks. All the oil lines are steam-traced and lagged to maintain the oil at 120°F at which temperature the viscosity is 5,000 sec Redwood No. 1. Oil for the boilers is taken from a 12in common suction main connected to the three storage tanks and pumped at 550 p.s.i. through two-stage steam/oil heaters, to raise the temperature to between 230 and 280°F, from which it is conveyed through an 8in ring main in the boilerhouse.

There are six Mirrlees screw type positive displacement oil pumps in the fuel oil pump house discharging at 550 p.s.i. Each pump is rated at 96,000 lb/hr capacity, and is driven by a 120 h.p. Lancashire Dynamo squirrel cage 3,300 V 980 r.p.m. motor. To provide steam for heating the traced oil tanks and pipes when the station is shut down there are three 10,000 lb/hr oil-fired 250 p.s.i. auxiliary Spencer-Bonecourt-Clarkson, Ltd., boilers. Steam for initial starting is supplied by a Bastian & Allen electrode boiler. When the station is running the heating steam is taken at 900 p.s.i. and 900°F from an auxiliary main, which can be connected to any of the first four units through a de-superheater and pressure reducing valve to an A.E.I. (Manchester) evaporating plant. This comprises three evaporators each designed to supply 25,000 lb/hr of dry saturated steam at 250 p.s.i.

The first four boilers have ten Peabody mechanical atomising type oil burners located on the front furnace wall while the boilers for Nos. 5 and 6 sets have sixteen.

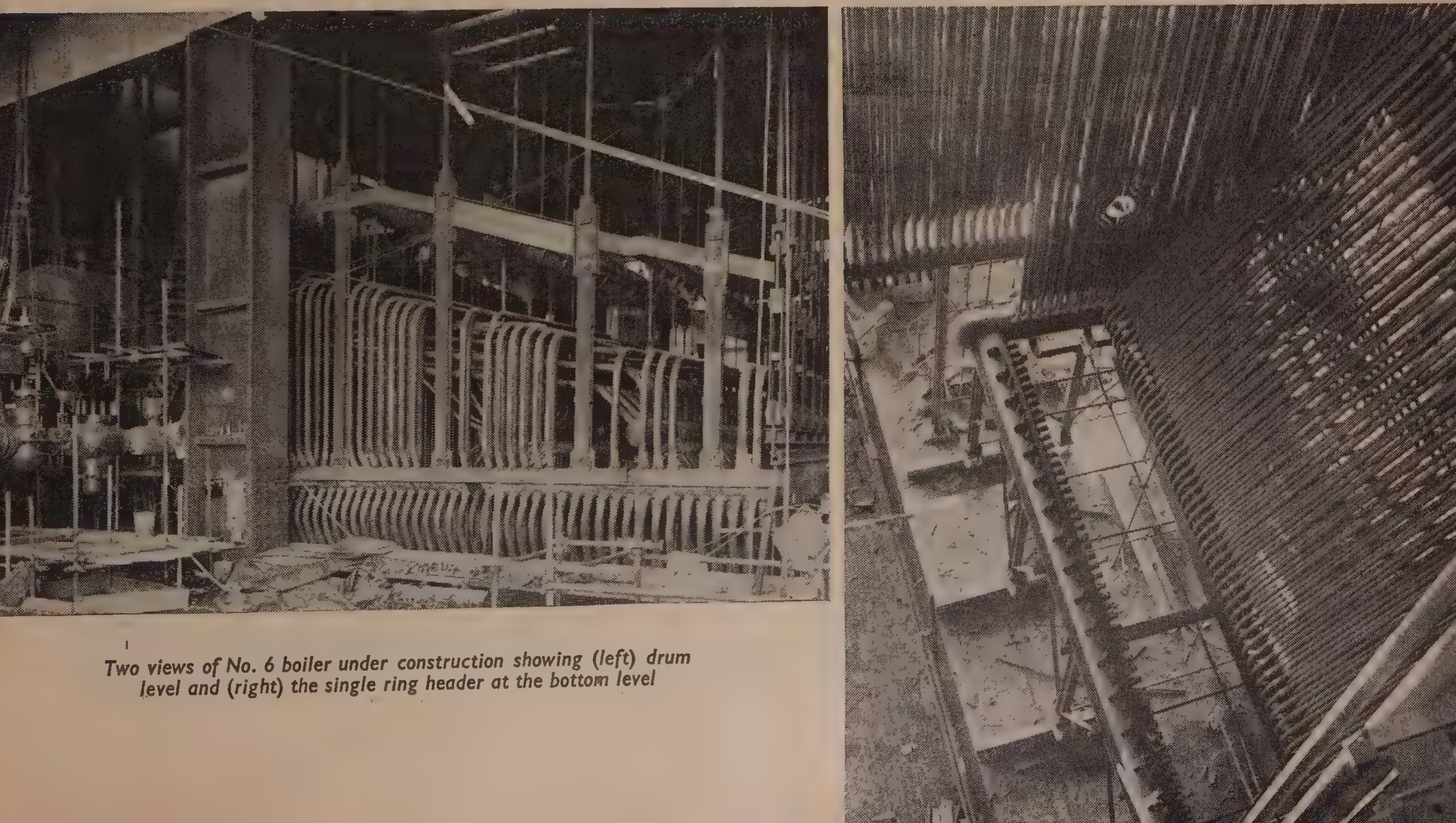
The lower bank of four burners is also fitted with steam atomisation for cold start-up, the steam being obtained from auxiliary boilers or the evaporating plant. All the burners are propane gas/electric ignited and are inserted by remote control from the unit control room. Ignition failure of the individual burners is detected by photo-electric cells, the oil supply being automatically shut off and the burners withdrawn and steam-purged. To give air register control on each burner a motor driven unit regulated from the boiler control system is fitted to the air louvre operation mechanism. This automatically adjusts the position of the air louvres over varying loads to ensure that the correct amount of spin is imparted to the combustion air to give efficient combustion conditions.

Steam-Raising Plant

All the boilers in the completed station will be of John Brown Land Boilers, Ltd., construction. Each is of the single drum Brown-Riley radiant type and has a solid forged drum suspended from the main building steelwork. Those for sets Nos. 1–4 are of 550,000 lb/hr maximum continuous evaporative capacity and have superheater outlet pressures and temperatures of 950 p.s.i. at 925°F, with a final feed temperature of 385°F. The all-welded wall tubed furnace is constructed of 3¼in o.d. hot drawn weldless tubes at 3⅜in centres forming a totally water cooled combustion chamber with no intermediate headers. The furnace dimensions are 30ft 4½in wide by 27ft 6in deep, the casing being supported from an independent steel structure. The heating surfaces comprise a projected furnace area of 9,200 sq ft and a boiler surface area of 9,273 sq ft. The primary superheater has a total effective surface area of 15,480 sq ft and is constructed of 2¼in o.d. carbon steel hot drawn tubes installed with a 5in pitch, while the secondary superheater has an area of 9,940 sq ft. In this superheater 2½in o.d. CrMo steel tubes are used arranged with a 5in pitch when placed parallel to the gas flow and a 10⅛in pitch when across it.

Fuel oil pump house

The boilers for Nos. 5 and 6 units are of 860,000 lb/hr capacity and have superheater outlet pressures and temperatures of 1,600 p.s.i. and 1,010°F with reheat to 1,005°F at 391 p.s.i. at the reheater outlet. The final feed temperature is 435°F. These boilers incorporate 3¼in o.d. tubes at $3\frac{5}{16}$in centres giving a furnace 33ft 11⅜in wide by 27ft ⅝in deep and the casing is carried by the tubes. There is 12,950 sq ft of heating surface in the furnace and 4,800 sq ft of boiler surface. Each has a self-draining primary superheater having a total effective surface area of 45,100 sq ft in three sections and using 2½in o.d. carbon steel and CrMo tubes. They also have a pendant radiant superheater with an area of 6,920 sq ft composed of 1½in o.d. CrMo steel tubes and a 4,600 sq ft pendant secondary superheater with 2¼in o.d. CrMo steel tubes. The reheater consists of three banks of self-draining tubes arranged in the gas stream parallel to the primary super-



Two views of No. 6 boiler under construction showing (left) drum level and (right) the single ring header at the bottom level heater and having a total heating surface of 42,190 sq ft. The lower bank is composed of 2½in o.d. hot rolled weldless mild steel tubes while CrMo tubing of 2½ and 2¼in o.d. respectively is used for the intermediate and top banks. All tubes are pitched at 4 31/32in centres across the gas stream.

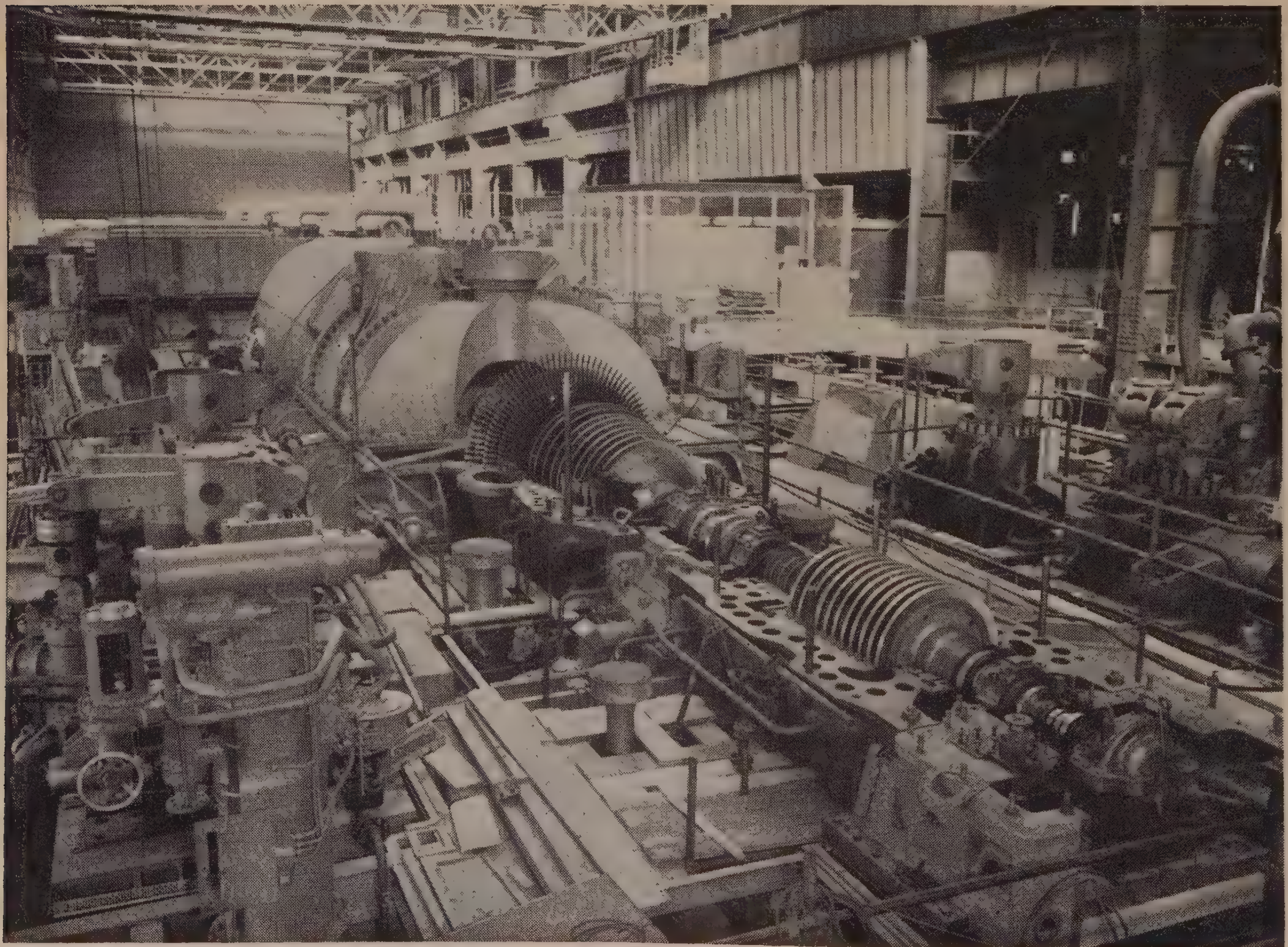
In all these boilers the rear, side and front headers at the bottom level are welded together to form a single ring header.

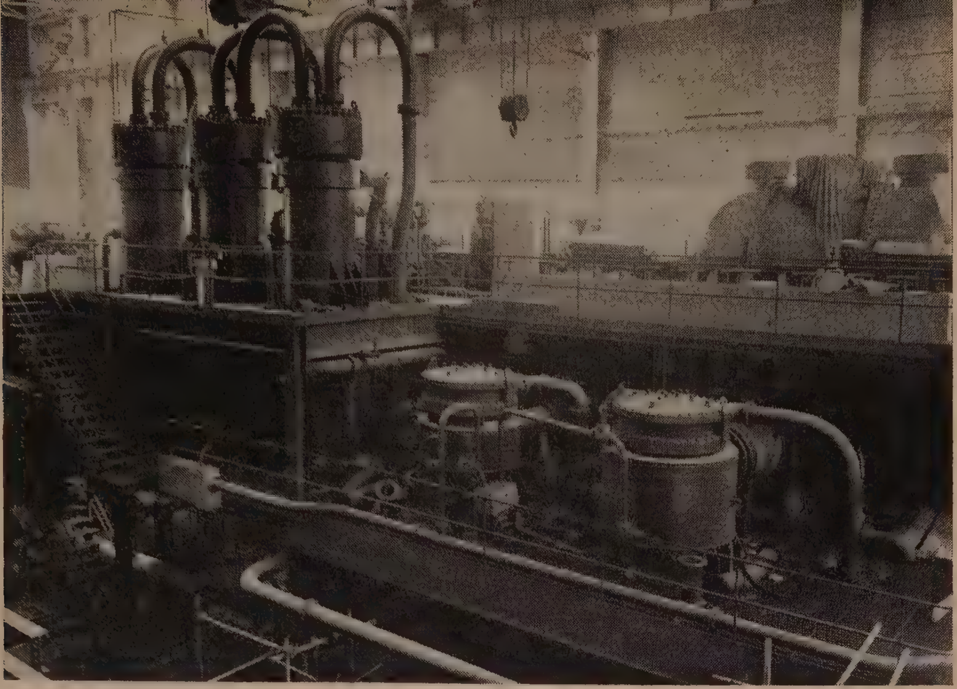
A Kent pneumatic system for automatic combustion control is fitted to all six boilers, the operation of which is based on the steam flow/air flow ratio. It consists of four separate loops. In the first the final steam pressure is metered by a three-term controller which operates a valve regulating the flow of fuel to the burners. The steam flow is also metered and the ratio of air to steam is controlled using the f.d. fans to a predetermined figure giving the required percentage CO_2 in the flue gases. The pressure in the combustion chamber is metered and used to control the i.d. fans to provide a balance of air to gas flow in the boiler. The steam temperature in boilers Nos. 1 to 4 is controlled by by-passing gas over the primary section of the superheater, with over-riding control by a spray type de-superheater installed between the primary superheater outlet and the secondary superheater inlet. For boilers Nos. 5 and 6 the superheater temperature control is by a spray type de-superheater and the reheat steam temperature control is by a damper in the gas pass with emergency spray regulators. The output from the metering equipment is converted to a pneumatic signal at an air pressure between 3 and 15 p.s.i. This can be used to provide proportional, integral or derivative control, being passed through a pneumatic relay to drive power cylinders controlling fan dampers or diaphragm motors operating valves in the fuel supply.

Air for combustion is taken from the top of the boiler house by Davidson forced draught fans, two for each boiler. The fans for the first four boilers are rated at 100,000 cu ft/min and are driven at 730 r.p.m. by constant speed 248 h.p. Lancashire Dynamo a.c. motors. For the two larger boilers the fans are rated at 152,000 cu ft/min, the motors being 433 h.p. Lancashire Dynamo machines. The air is preheated before entering the furnace by passing through two Howden-Ljungstrom type horizontal rotary heaters. There are two Davidson induced draught fans for each boiler, each driven by a 742/592 r.p.m. 340/185 h.p. Lancashire Dynamo a.c. motor and rated at 154,000 cu ft/min in the case of the first four units and by a 720/447 h.p. Lancashire Dynamo motor and rated at 244,000 cu ft/min for units 5 and 6. The forced and induced draught fans are controlled by variable inlet vanes operated by pneumatic slaves regulated from a main controller.

The dust extraction equipment consists of Musgraves "Aerodynamic Collector" arrestors using the Linderoth system for boilers 1–4 and Davidson "Sirocco" cellular

The first 120 MW set, No. 5, under construction





The feed heating train for No. 5 unit

dust collectors for Nos. 5 and 6. These will operate initially under oil firing conditions but will also be suitable for use with coal in conjunction with electrostatic precipitators. The dust is removed by a John Thompson Industrial Constructions Co. vacuum plant to a central container and then disposed of by road transport. Automatically operated soot blowing equipment was supplied by Clyde Blowers, Ltd., the blowers being controlled in sequence from panels situated in the unit control rooms. Steam for soot blowing is taken from the primary superheater outlet at 950 p.s.i. Provision is made on the boilers and in the control equipment for adding further blowers if coal firing is adopted. Each boiler is provided with zinc injection equipment to provide a measure of protection against the formation of acidic smuts.

There are two 9in diameter CrMo main steam pipes from the boiler stop valves to the turbine stop valve in each of the first four units. For the last pair of units the main steam pipes are two 8in diameter CrMo cold drawn tubes, and from the turbine to the reheater there are two 15in carbon steel pipes, the return from the reheater to the set being through two 16in CrMoVa steel pipes.

Generating Plant

All of the turbo-generator sets are of English Electric manufacture. The turbines of the 60 MW sets, arranged transversely in the turbine hall, are three-cylinder impulse reaction machines with double-flow low-pressure cylinders exhausting to twin condensers. With steam conditions at the turbine stop valve of 900 p.s.i. and 900°F and a vacuum of 28·9in Hg at the condenser flange, the estimated steam and heat consumption at maximum continuous rating is 8·406 lb/kWh and 9,180 B.Th.U./kWh for Nos. 1 and 2 sets, and 8·383 lb/kWh and 9,155 B.Th.U./kWh for sets 3 and 4. In the high-pressure cylinder is a Curtis wheel and 16 pressure-compounded impulse stages. The intermediate-pressure cylinder contains 14 impulse stages while the double-flow low-pressure cylinder has two sets of eight stages comprising one impulse and seven reaction. Turbovisory equipment is provided on these machines to indicate and record the turbine speed and set output, rotor eccentricity for the h.p. and i.p. cylinders, the rotor/casing differential expansion in both the h.p. and i.p. cylinders and the h.p. cylinder pedestal displacement.

The three-cylinder impulse reaction reheat type 3,000 r.p.m. turbines of the two 120 MW sets are positioned longitudinally in the turbine hall and are designed to operate with steam conditions at the turbine stop valve of 1,500 p.s.i. and 1,000°F with reheat to 1,000°F at 360 p.s.i.g. at the inlet to the intermediate pressure turbine. These sets exhaust to twin condensers operating at 28·9in Hg vacuum. The specified steam and heat consumption for these sets at m.c.r. is 6·708 lb/kWh and 8,211 B.Th.U./kWh. The h.p. cylinder has a Curtis type first stage and ten impulse stages and the i.p. cylinder has nine reaction stages while the triple-flow l.p. cylinder has one impulse and six reaction stages in each section. A more comprehensive system of turbovisory equipment is provided for these machines, information being indicated and recorded concerning the turbine speed and set output, the h.p. and i.p. rotor eccentricity, the h.p. and i.p. rotor/casing differential expansion, the h.p. casing temperature and pedestal displacement, and the i.p. steam temperature and casing temperature. In addition, pedestal vibration is registered at the steam end of the h.p. cylinder, between the h.p. and i.p. and the l.p. and i.p. cylinders and at the alternator end of the l.p. cylinder in addition to the steam and exciter ends of the alternator.

Nos. 1 to 4 sets have flexible couplings between cylinders, the machines being anchored at the l.p. cylinder while the two larger units have rigid couplings, the machine being anchored at the l.p. cylinder and at a point in line with the i.p./l.p. coupling.

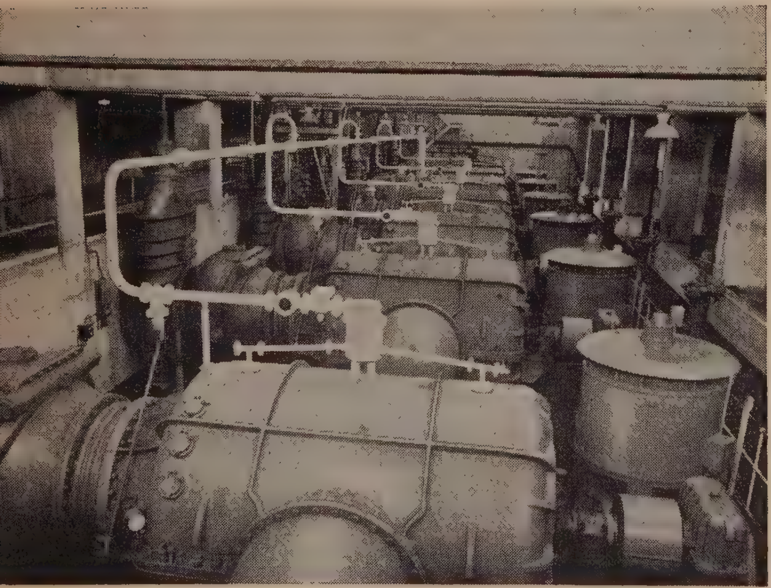
All machines have a steam chest on each side of the h.p. cylinder each containing a throttle valve. The centrifugal governor is accommodated in the steam end pedestal and is driven from the turbine shaft by single helical gearing. The governor controls the oil relay valve which in turn controls the throttle valves. On all sets an oil valve operated by the governor anticipator is fitted to each secondary relay so that the main throttle valves are closed rapidly on sudden loss of load. In the case of Nos. 5 and 6 turbines the governor also controls the reheater interceptor valves before the i.p. turbine.

Under normal running conditions the interceptor valves are fully open but they are arranged to begin closing if the set speed increases to 2 per cent above normal and to be completely closed if the speed rises to 4 per cent above normal. The position of the interceptor valve is not affected by load changes on the turbine.

The main centrifugal type oil pump is also driven from the turbine shaft and supplies oil at high pressure to the relay valve from which it passes through a regulating valve to the lubrication system. A 100 per cent duty a.c. motor driven auxiliary oil pump is provided as a standby. Each unit also has a small d.c. motor driven auxiliary oil pump arranged to start automatically in the event of a.c. supply failure, for lubrication purposes only. A separate a.c. motor driven auxiliary pump is available to supply oil to the bearings whilst the turbine is on barring.

Steam exhausts from each flow of the l.p. cylinders into two-pass surface type condensers, those for Nos. 1 and 2 sets being supplied by the Mirrlees Watson Co., the remainder being of Vickers Armstrongs (Engineering) Co. manufacture. The total condenser cooling surfaces are 52,000, 46,000 and 65,000 sq ft for Nos. 1 and 2, 3 and 4 and 5 and 6 sets respectively, the corresponding condensate quantities being 365,428, 362,050, and 573,000 lb/hr, at a temperature of 81·8°F.

The air exhausting plant consists of two 100 per cent duty air ejectors for the 60 MW units rated at 185·7 lb of air per hour for Nos. 1 and 2 sets and 180 lb per hour for Nos. 3 and 4. Each of the two larger sets has three 50 per cent duty air pumps rated at 125 lb of air per hour each. These pumps are driven by 125 h.p. Metropolitan-Vickers motors. On No. 2 machine an experimental low-pressure ejector is being fitted which will enable vacuum to be raised in the set before the boiler reaches its rated output pressure.



There are seven "Deptford" pressure type screens in the c.w. pump house. On the right can be seen the 850 h.p. c.w. pump motors

Condensate is extracted from each of the condensers by two 100 per cent duty pumps. Those for Nos. 1 and 2 sets are rated at 700 gal/min and each is driven by an 85 h.p. 970 r.p.m. motor, whilst those for Nos. 3 and 4 sets are rated at 780 gal/min and are driven by 120 h.p. 1,465 r.p.m. motors. For Nos. 5 and 6 sets the pumps are rated at 1,170 gal/min capacity and are driven at 970 r.p.m. by 140 h.p. motors. The condensate passes through a drain cooler and five stages of feed heating with an additional stage provided for the two larger sets. The first two stages are l.p. heaters and the third is a direct contact high level de-aerator heater for which off-load de-aeration is provided. This is followed by two h.p. heaters in the case of Nos. 1 to 4 sets, after which the condensate is passed to the boilers by 100 per cent duty feed pumps, three being provided for each pair of sets. These have been supplied by the Harland Engineering Co., Ltd., each rated for 650,000 lb/hr capacity and driven by a 1,400 h.p. motor.

After condensate from Nos. 5 and 6 sets has been passed through the de-aerator heater its pressure is raised to 650 p.s.i. by 100 per cent duty G. & J. Weir 965,000 lb/hr booster feed pumps, two being provided for each set, before being passed through three h.p. heaters. Each of the feed pumps is driven by an 860 h.p. English Electric motor. The main boiler feed pumps for Nos. 5 and 6 sets are also of G. & J. Weir manufacture, two 100 per cent duty pumps being provided for each set. The pumps are rated at 965,000 lb/hr capacity and are each driven by a 2,560 h.p. variable speed English Electric motor. The final feed temperature of the first four sets is 385°F and for Nos. 5 and 6 units is 435°F. Make-up water, obtained from the Metropolitan Water Board, is treated by the Permutit "Starvation"/mixed bed "Deminerolite" process.

All the condenser cooling water required is obtained from the River Thames. The c.w. pump house contains seven 3,000,000 gal/hr Drysdale pumps driven by 850 h.p. English Electric motors. The water intake is under the centre of the jetty and at this point are the coarse screens. After each of the c.w. pumps there is a "Deptford" pressure type screen in which the water is passed through a horizontal rotating drum manufactured by Richardsons, Westgarth. A Wallace & Tiernan automatic programme controlled chlorinator is incorporated to limit marine growth. The discharged cooling water passes along a culvert, through a penstock and over a weir to the bottom of a shaft from which a small proportion is pumped to the aeration plant between the two chimneys. Air is pumped into this water which is returned to the bottom of the shaft rejoining the c.w. discharge. The c.w. outlet is nearly one half mile downstream from the jetty.

Hydrogen Cooled Alternators

All of the six English Electric alternators are hydrogen cooled. The first two 60 MW sets operate at 0·8 power factor and are rated at 75,000 kVA, while Nos. 3 and 4 sets operate at 0·9 power factor, being rated at 66,667 kVA. The two 120 MW sets are rated at 132,000 kVA, operating at 0·9 power factor. Ventilation for all machines is by axial flow type fans mounted on each end of the alternator rotor with oil/gas seals and circulating hydrogen gas at pressures of 5 p.s.i. for sets 1 to 4, although the design pressure is 15 p.s.i. for these sets and 30 p.s.i. for Nos. 5 and 6 sets for which the optimum working pressure has yet to be determined. Each machine has two hydrogen coolers supplied with distilled water flowing in a closed circuit. This water is circulated by one of two 100 per cent duty electrically driven pumps through one of two 100 per cent duty tubular surface type heat exchangers. Cooling water for the heat exchangers is supplied from the main c.w. system. A Napier thrust or face

Air pumps and control panel in the c.w. aeration plant. On the left is part of the surge shaft

type hydrogen seal, designed to keep the oil-hydrogen surface to the minimum, has been fitted to No. 4 set. Machines Nos. 1 to 4 and No. 6 are provided with a conventional gear driven d.c. generator and pilot exciter. No. 5 machine, however, has a direct drive a.c. alternator with a silicon rectifier to provide the excitation supply. Sets Nos. 1 and 2 have been equipped with a Metropolitan-Vickers Type VTSR voltage regulator, the remaining machines being equipped with Type MAEX English Electric regulators.

Nos. 1 and 2 alternators generate at 11·8 kV and Nos. 3 and 4 at 11·6 kV. They are solidly connected to 72 and 64 MVA generator transformers respectively having o.f.w. cooling and on-load tap changers. The connections are in the form of condenser bushings. The unit transformer and voltage transformer tee-off connections are of bare copper enclosed in cellular cubicles. The unit transformers are o.n. cooled 5 MVA equipments which reduce the voltage to 3·45 kV. For Nos. 5 and 6 sets, which generate at 13·8 kV, the 128 MVA generator transformers are o.f.w. cooled and have on-load tap changers. The main connections between these machines and their transformers are bare copper bars on porcelain insulators and are enclosed in aluminium trunking with complete phase segregation. The unit and voltage transformer connections are bare copper enclosed in concrete cellular cubicles. The unit transformers for these sets are o.n. cooled and reduce the voltage to 3·45 kV, but in this instance are rated at 10 MVA. Connections between the generator transformers and the 132 kV air blast circuit-breakers at the switching station some six to seven hundred yards distant are by gas filled cables. The four o.n. cooled 7·5 MVA station transformers have on-load tap changers and are situated at the 132 kV switching station. These reduce the grid voltage to 3·45 kV and the l.v. connections to the 3·3 kV house service switchboard are by single-core p.i.l.c. cables.

The 132 kV switching station is of the hall type, the main building being 600ft long, 80ft wide and rising to 55ft above ground level. Since the site was flooded in 1953 no equipment is accommodated below +7·5ft O.D. and there is additional flood protection to +12ft O.D. Within the site boundary are also four double-circuit overhead line terminal towers and three 90 MVA 132 kV busbar reactors in addition to the station transformers. In the switching hall the switchgear is arranged in four sections, each having main and reserve busbars. English Electric air-blast 3,500 MVA rupturing capacity circuit-breakers are installed. The busbars are 3in o.d. copper tube with a 16 s.w.g. wall thickness and a current rating of 1,200 A. An article describing this switching station will appear in our next issue.

Plant Control Rooms

The station is designed on the unit principle. Two units are controlled from each of the three unit operating stations. Each unit has a composite boiler/turbine control and instrument panel from which its operation and loading are controlled. These stations are situated at the operating floor level and are between each pair of units. All electrical connections to the panels are terminated in a chamber below the control room into which the terminals from the panels project. The main control room is situated at the centre of the operating floor level and contains the 132 kV switchgear control panels, the generator control desk for the six machines, the automatic voltage regulator cubicles and a 3·3 kV house service switchgear control panel. From this room the generators are synchronised and loading instructions are relayed to the staff in the unit operating stations.

The 3·3 kV house service switchgear and unit boards for Nos. 1 to 4 sets incorporate compound-filled busbars with vertical isolation oil circuit-breakers of A.E.I. manufacture. The unit boards for Nos. 5 and 6 sets have English Electric air circuit-breakers. The Electric Construction Co., Ltd., supplied the 415 V switch and contactor gear which is of cubicle construction with insulated busbars and connections. Cold cathode lighting (Falk, Stadelmann & Co., Ltd.) is provided in the turbine house, while the main and unit control rooms have fluorescent tubes with a.c./d.c. automatic changeover equipment provided by the Atlas Lighting Co., Ltd.

The station was originally engineered by the Construction Department of the London Division of the C.E.A. and since the formation of the C.E.G.B. by the Southern Project Group. The consulting engineers for the c.w. tunnels were Messrs. Mott, Hay & Anderson and the executive architects were Messrs. Farmer & Dark. The principal contractors included:—Foundations—J. Mowlem & Co., Ltd.; structural steelwork—Sir William Arrol & Co., Ltd.; superstructure—M. J. Gleeson (Contractors), Ltd.; c.w. tunnels — A. Waddington & Son, Ltd.; boilers—John Brown Land Boilers, Ltd.; oil burning equipment—Peabody, Ltd.; fuel oil and heating steam pipework and valves and h.p. and l.p pipework—Aiton & Co., Ltd.; turbo-generators—English Electric Co., Ltd.; condensing plant and feed heating sets—Mirrlees Watson Co., Ltd., and Vickers-Armstrongs (Eng.), Ltd.; c.w. pumps and aeration plant—Drysdale & Co., Ltd.; c.w. strainers — Richardsons, Westgarth (Hartlepool), Ltd.; generator and station transformers—Hackbridge & Hewittic Electric Co., Ltd.; 132 kV cabling—British Insulated Callender's Cables, Ltd.

Acknowledgment is due to the Southern Project Group of the C.E.G.B. for assistance in preparing this article.

Application of Power Rectifiers

Major changes in the applications of power rectifiers have been brought about by the development of semiconductor elements and improvements in grid control techniques. In this article, which is based on a paper presented in March to the Utilisation Section of the Institution of Electrical Engineers, the suitability of the various types for a number of applications is surveyed and details are given of supply considerations, methods of protection, auxiliaries and installation

IN the past ten to fifteen years there has been a large increase in the use of power rectifiers and within the past few years two notable changes have taken place in their application. The development of germanium and silicon monocrystalline semiconductor rectifiers in suitable ratings has provided a more efficient and compact alternative to selenium-iron and mercury arc rectifiers for most constant voltage and for many variable voltage applications. Improvement in grid control techniques has made mercury arc rectifier controlled d.c. motor drives competitive with Ward Leonard and a.c. motor drives for many applications, including those requiring reversal of power. This changing pattern is illustrated in Table 1 which shows the present most suitable types of rectifier available for the more common applications and, where appropriate, gives an indication of possible future trends.

Where their suitability overlaps, the various established types of rectifier can give equally reliable service. Choice of equipment within any group in Table 1 will therefore depend on operating duty, capital and operating costs, space requirements and servicing facilities. For very fast or sensitive voltage control mercury arc rectifiers are necessary for most applications and for the voltage control of large powers steel-tank are better than glass-bulb equipments. For most applications the merits of germanium and silicon rectifiers are similar. Their efficiency and costs are of the same order and their protection requirements are the same. The higher operating temperature of silicon cells may occasionally be of advantage but, as this is usually considered in the equipment design, it does not automatically give the facility of higher overload capacity or higher ambient or cooling air limits. There have, however, been over five years' useful operating experience with germanium rectifiers covering most of the applications of Table 1 whilst silicon has yet to be proved.

Capital costs include equipment, building, ventilation or cooling equipment and installation costs, while operating costs, on which efficiency may have an important effect (see Table 2) include maintenance expenses. For equivalent ratings germanium and silicon are more compact than selenium-iron and mercury-arc rectifiers, they are inherently simpler than and free from the low-temperature limitations of the latter, have fewer auxiliaries and are easier to service at long distances from the factory.

Various types of grid control circuit have been developed for regulating the output voltage of mercury arc rectifiers. Basically, they all comprise a fixed negative bias on the control grids and a firing pulse which

TABLE 1.—APPLICATION RANGE OF SEMICONDUCTOR AND MERCURY ARC RECTIFIERS

Application	Rectifier Type
Industrial uses of various kinds where voltage control (if any) can be of moderate speed, e.g. factory and dock supplies, cranes, lifts, motor starting and speed control, exciters for large alternators, etc.	**Medium and large sets.**—Germanium, silicon or multi-anode mercury arc depending on circumstances and voltage control. Increasing tendency to use germanium or silicon. **Small sets.**—Selenium.
Industrial uses requiring fast or sensitive voltage control or inversion, e.g. reversing mill drives, winders, many auxiliary drives, paper machines, printing presses, field-forcing of large d.c. or a.c. machines, etc.	**Medium and large sets.**—Multi-anode steel-tank mercury arc. **Small and some special medium-size sets.**—Single-anode (hot-cathode, ignitron or excitron) mercury arc.
D.c. railway substations.	Multi-anode mercury arc, germanium or silicon.
50 c/s locomotives and motor coaches, non-regenerative.	Silicon, germanium, or single- or multi-anode mercury arc. Increasing tendency to use silicon or germanium.
As above but with regenerative braking.	Single- or multi-anode mercury arc.
High-power electrolysis, e.g. for aluminium, copper, zinc, chlorine, hydrogen, etc.	***Above about 250 volts.**—Germanium or silicon. **Up to about 250 volts.**—Germanium.
Battery charging, electrolytic cleaning or tinning, electro-plating.	Selenium, germanium or silicon, with increasing tendency to use germanium or silicon.
Mining service underground, d.c. electric furnaces, e.g. for titanium, and arc welding.	Germanium, silicon or selenium.
Electrostatic precipitators, high-voltage d.c. testing equipment.	*Usually selenium, but may be silicon in future.
Anode supplies for radio transmitters.	Usually special single-anode mercury arc, but may be silicon in future.
Nuclear research, usually involving high power switching or inversion.	Special mercury arc, usually single-anode.

* Although there are many existing mechanical rectifiers in these applications, it is unlikely that others will be provided in the future because of the outstanding advantages of semiconductor rectifiers for such duties.

TABLE 2.—RECTIFIER EFFICIENCIES

Direct Voltage	Efficiency*			
	Mercury Arc†	Selenium-Iron‡	Germanium	Silicon
Volts	%	%	%	%
25	—	92	97	94
50	—	92	98	97
100	82–83	92	98½	98
200	90–91	92	98½	98
300	93–94	92	98½	98
400	94½–95	92	98½	98½
500	95½–96	—	98½	98½
750	97–97½	—	98½	98½
1,000	97½–98	—	98½	98½
1,500	98½	—	98	98
3,000	98½	—	98	98

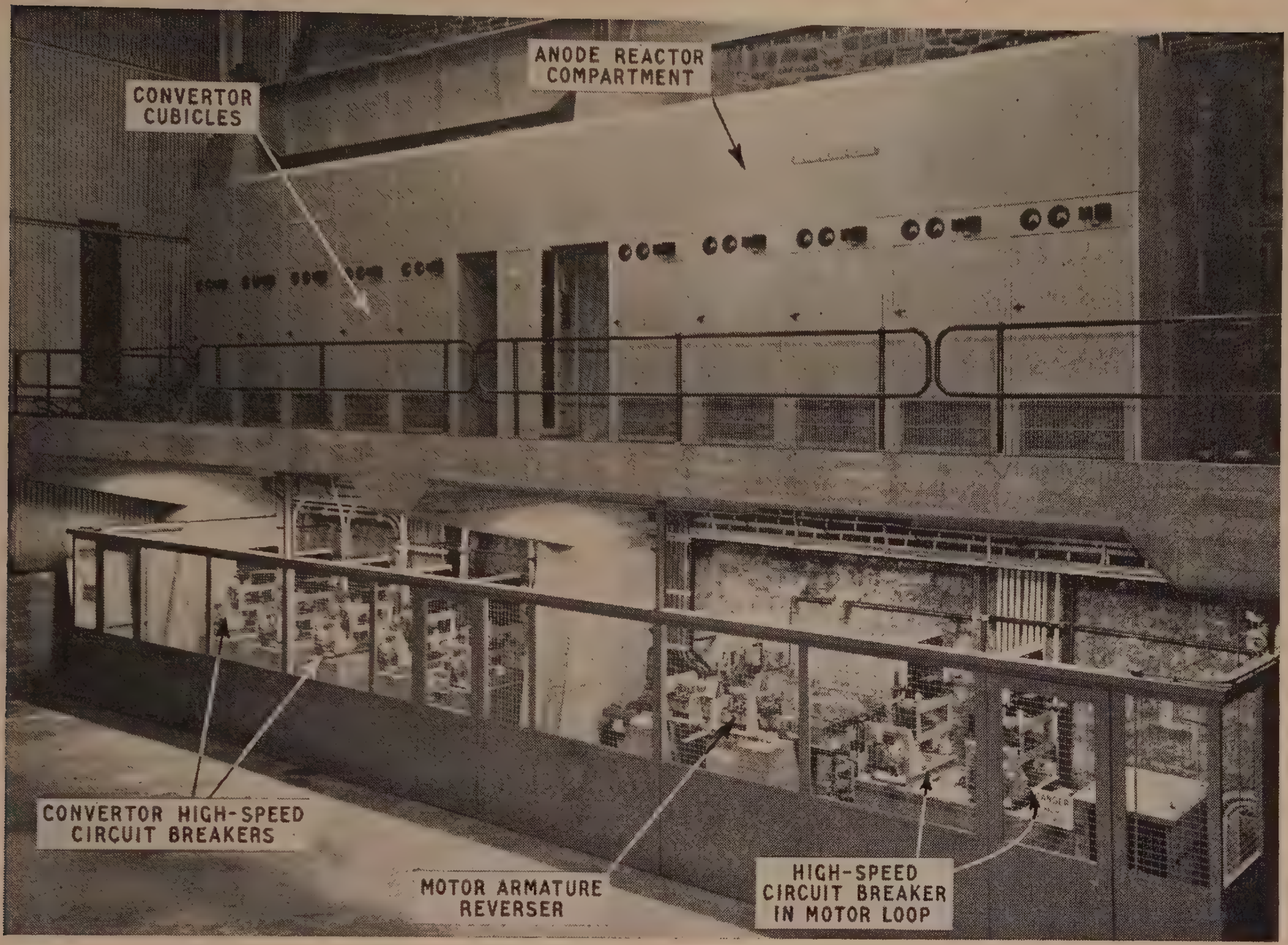
* Overall efficiencies, including transformer losses, are 1½–4 per cent less than this, depending on the rating of the equipment (transformer efficiencies increase with rating) and on the type of transformer connection used. Transformer efficiencies tend to be about ½ per cent higher for semiconductor equipments with direct voltages above about 100 volts.

† Mercury arc rectifier efficiencies vary slightly with the different types and designs available.

‡ The efficiencies given for selenium-iron rectifiers are when new, and they fall with age. B.S. 2709: 1956 specifies that the fall in efficiency should not exceed 10 per cent during the first 2,000 hours of service.

and Convertors*

By J. P. McBREEN, A.M.I.E.E.†


ANODE REACTOR COMPARTMENT
CONVERTOR CUBICLES
CONVERTOR HIGH-SPEED CIRCUIT BREAKERS
MOTOR ARMATURE REVERSER
HIGH-SPEED CIRCUIT BREAKER IN MOTOR LOOP

Convertor equipment for a 4,000 h.p. reversing mill drive. (Photo by courtesy of Samuel Fox & Co., Ltd.)

overcomes the bias and permits the anodes to fire in sequence, the control being achieved by varying the instant at which the main anodes are allowed to fire. Sometimes on- or off-circuit tap-changers or regulating transformers are used in conjunction with the grid control if prolonged operation at reduced voltage is necessary.

The method of voltage control used with semiconductor rectifiers varies according to the application and rating. For the smaller ratings full range voltage control may be provided by incorporating a regulating transformer in the supply. For larger ratings, on- or off-circuit tap-changers may be used with or without transductor control to give smooth control between taps.

A certain amount of short-time overload capacity is often desirable for many applications and providing this involves many complex considerations. The rectifier equipment consists of components having widely different heating time constants, while commutating ability of the rectifier rather than thermal capacity is often its limiting factor. Care must be taken when specifying the magnitude and duration of overloads if unnecessary expenditure on equipment is to be avoided. The five rating classes of B.S. 1658:1950 are a useful guide to accepted practice in this respect.

Supply Considerations

With the growth in the use of rectifiers and of the a.c. supply system networks, supply considerations which affect the design of the rectifier equipment have become more important, especially for the larger ratings. Depending on the pulse number‡ the waveform of the current drawn by a rectifier from the supply contains a number of harmonic currents, each a percentage of the fundamental supply current to the rectifier. In passing through the supply system these harmonic currents induce corresponding harmonic voltages across the impedances through which they pass. These voltages are, in their turn, propagated throughout the associated parts of the supply network and they could interfere with the operation of other consumers' equipment. Whether or not such interference takes place depends on the magnitude of the harmonics, on the impedance and arrangement of the supply system, and on the construction of the apparatus liable to be affected by the harmonics. By suitable attention to any one of these, interference can be reduced to an unobjectionable level, but usually considerations of cost prevent any of them from reaching the ideal and compromise is necessary.

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* The term "convertor" is often used when both rectification and inversion are involved, but to save repetition the more familiar term "rectifier" is used throughout the text.

† A.E.I. Heavy Plant Division.

‡ The pulse number is the number of main crests produced in the direct voltage during one period of the fundamental frequency of the supply voltage. It is often referred to as the number of phases, which can be confused with the number of transformer secondary phases and these are not always the same, or as the number of effective phases.

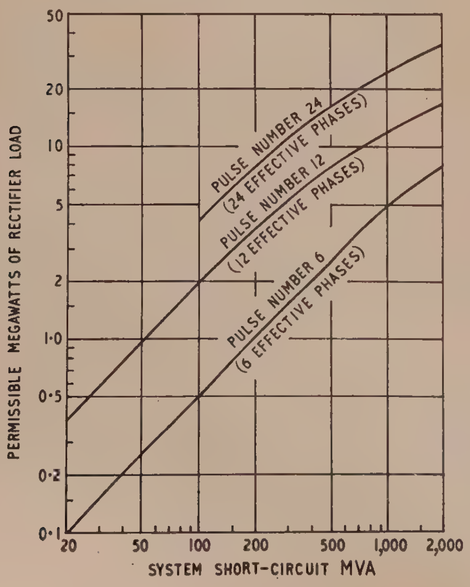
In so far as the rectifiers and the supply are concerned, this compromise is embodied in the Central Electricity Authority Engineering Recommendations G5/1, "Harmonic Distortion Caused by Mercury Arc Rectifiers," which the local supply authorities in this country use as a guide when deciding what rectifier capacity to permit on a particular system. Basically, the permitted rectifier loading is limited according to its pulse number and the minimum operating short-circuit capacity of the system as shown in Fig. 1. The rectifier loading referred to in this figure is the sum of all the rectifier loadings in any 30 minutes at the point of common coupling with other users, and the system short-circuit capacity is the minimum operating value and not the value normally specified for a.c. circuit-breaker rating. This relationship is only directly applicable to rectifiers without grid control other than that required for occasional motor starting or small-range voltage control. When considering the supply to rectifiers with wide-range grid control of voltage, the increased amplitude of the harmonics in the supply to such rectifiers has to be taken into account.

In the case of rectifier controlled d.c. motor drives having frequent reversal or starting duty there is a further and often more critical limiting relationship between the rectifier rating and the supply system capacity. The starting current for such drives may be up to three times the nominal full load value and although the power factor of a free firing rectifier lies between 0·95 and 0·97, it reduces in proportion to any reduction in voltage by grid control as shown in Fig. 2. Because of this low power factor at reduced voltages starting up such drives from rest imposes large reactive power demands on the supply system. As supply system impedances are usually predominantly reactive it follows that any reactive power demand must cause a corresponding drop in the system voltage of approximately:—

$$\frac{\text{Total new MVAR demand} - \text{Previous total MVAR demand}}{\text{System short circuit MVA} + \text{Total new MVAR demand}} \times 100 \text{ per cent}$$

and any varying reactive power demands must cause a fluctuation in the system voltage of the same order. The greater the fluctuation or its frequency the greater will be the risk of causing annoyance to other consumers connected to the same supply system. Other loads, such as arc furnaces, have a similar effect on the supply but permitted limits of supply voltage fluctuation caused by such loads have yet to be established. At various times attempts have been made to devise means of improving the power factor of grid controlled rectifiers operating at low voltage, but all the schemes proposed so far* have involved a considerable increase in the cost of the equipment and complication of circuitry. Taking the supply to the rectifier from further back in the system has usually proved to be the simplest and least expensive method of reducing the supply voltage fluctuation caused by rectifier controlled d.c. motor drives with frequent starting duty.

Fig. 1.—The rating and pulse number of a rectifier installation related to system short-circuit capacity



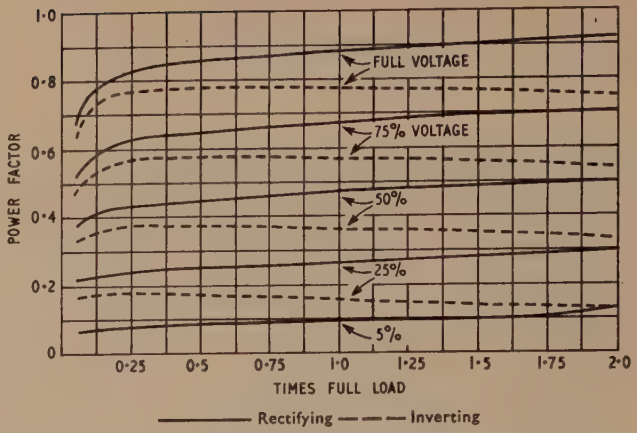


Fig. 2.—Typical variation of the power factor of a mercury arc rectifier with load when its output voltage is varied by grid control. Conditions: 12-pulse operation; $X = 8$ per cent; $I_m = 2\frac{1}{2}$ per cent and allowance of 15 per cent for supply-voltage dip during inversion. Voltage maintained constant at stated value

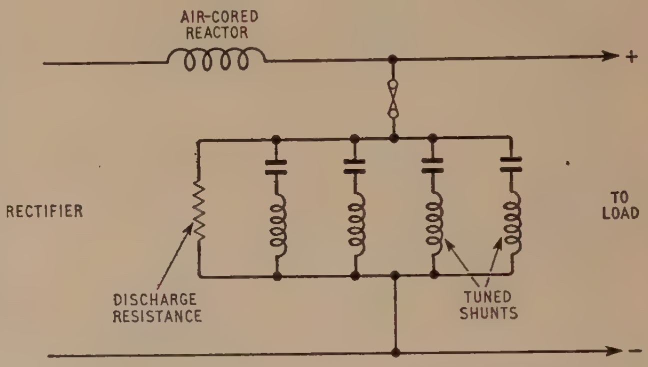


Fig. 3.—Smoothing equipment for six-pulse operation

The output from a rectifier contains a ripple made up of a number of harmonics depending on the pulse number used for rectification. With six pulses and over, these harmonics are of such a low value that they can usually be ignored, but occasionally it is necessary to suppress them. The normal form of smoothing equipment used with a six-pulse rectifier is shown in Fig. 3. In this

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* Korb, F., "Sequence Control for Reducing the Reactive Power of Rectifiers." *Engineers' Digest*, June, 1958, page 233.

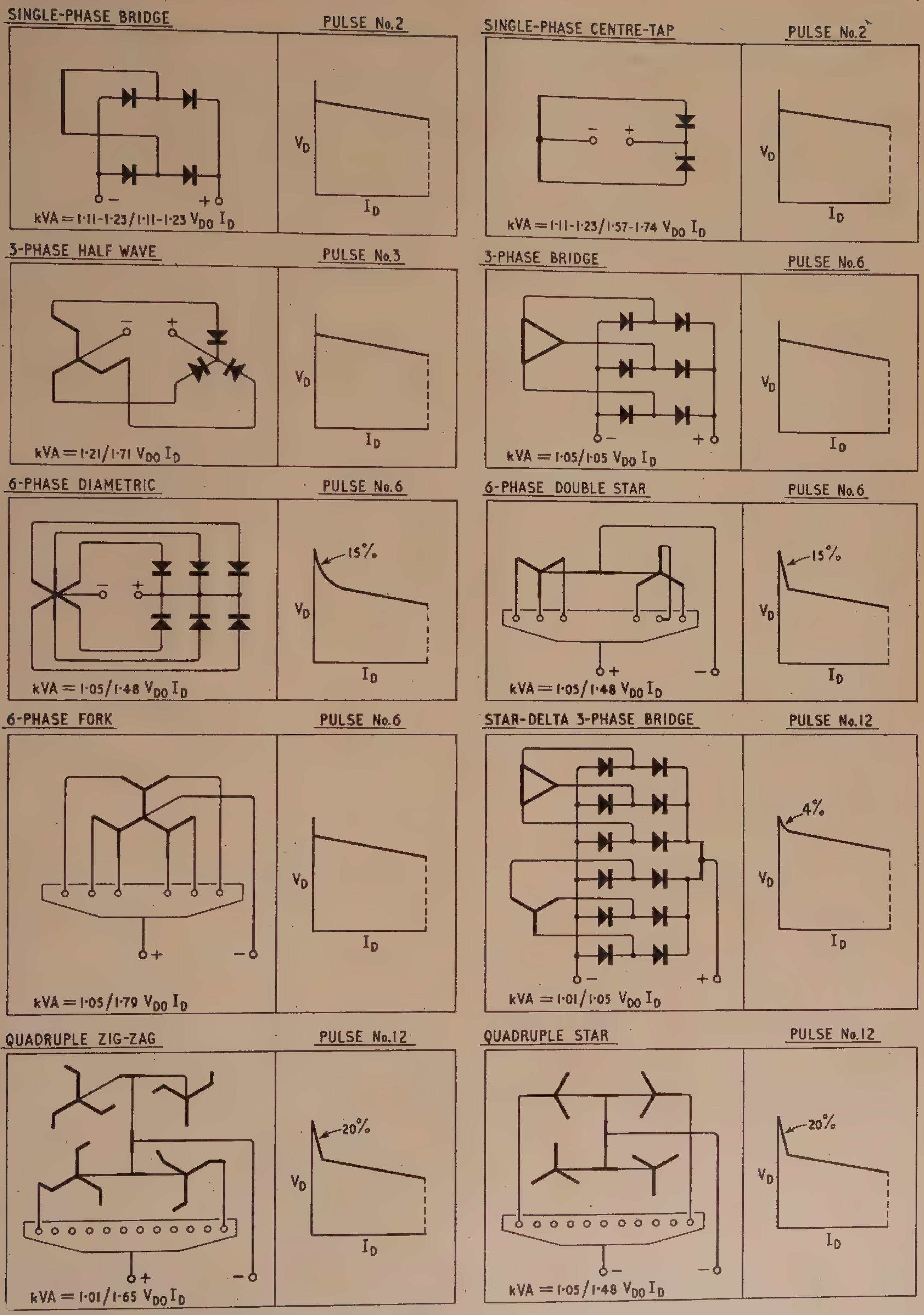


Fig. 4.—Commonly used rectifier connections with their regulation characteristic and transformer rating

V_{DO} = Theoretical no-load direct voltage at $\alpha = 0°$ i.e. value which would be obtained in the absence of rectifier drop and with interphase transformers (if any) fully magnetised.

I_D = Direct current load.
Regulation percentages from light load to full load vary with reactance and transformer copper loss.

arrangement the resonant shunts are tuned to have as near zero impedance as practicable to the principal harmonics, i.e. to the 6th, 12th, 18th and 24th, thus allowing these harmonics to by-pass the external d.c. circuit. In a 12-pulse equipment the resonant shunts for the 6th and 18th harmonics and possibly the series reactor would be omitted. With the use of rectifiers mounted on motor coaches and locomotives for 50 c/s traction applications two pulse circuits have had to be used and in such applications it is usual to include a series reactor to limit the ripple in the direct current to ±30 per cent of the mean value and to use a motor which can accept such a ripple.

Rectifier and Transformer Connections

The more frequently used rectifier and transformer connections are shown in Fig. 4. In general, the single-way connections, i.e. the single-phase centre-tap, three-phase half-wave, six-phase diametric, double-star and fork and the quadruple zig-zag and star connections, are used with mercury arc rectifiers whilst the double-way connections, i.e. the bridge connections, are used with semiconductor rectifiers. The diametric and double-star connections are also occasionally used with very-low-voltage semiconductor rectifiers. The high-voltage rise at light load, which is a characteristic of some of the connections, usually causes no inconvenience but it can easily be suppressed if necessary by arranging for a loading resistor to be switched across the d.c. busbars at light load.

When more than 12-pulse operation is required to reduce the harmonics in the supply current, and this is often necessary with very large ratings, a number of six-phase transformers may be used and supplied via phase shifting auto-transformers as shown in Fig. 5. Alternatively, six-phase transformers with extended primary windings, as shown in Fig. 6, may be used.

These illustrations are for 24-pulse operation but other groupings are also possible.

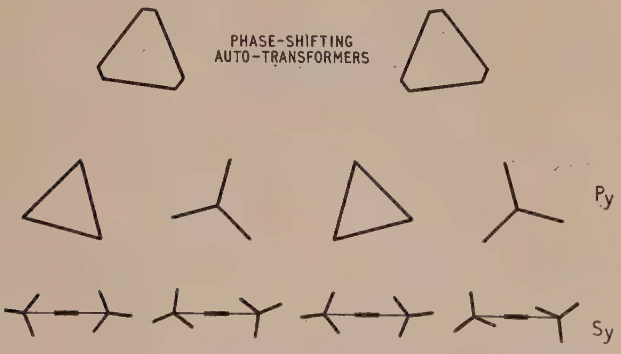


Fig. 5.—Phase multiplication from 6- to 24- phase using phase shifting auto-transformers

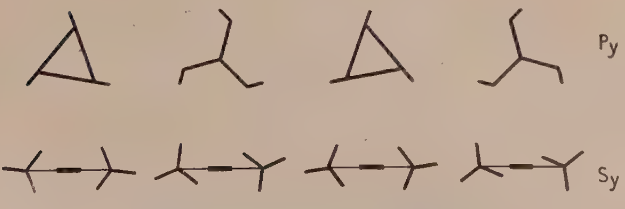


Fig. 6.—Alternative method of phase multiplication from 6- to 24- phase using extended primary windings

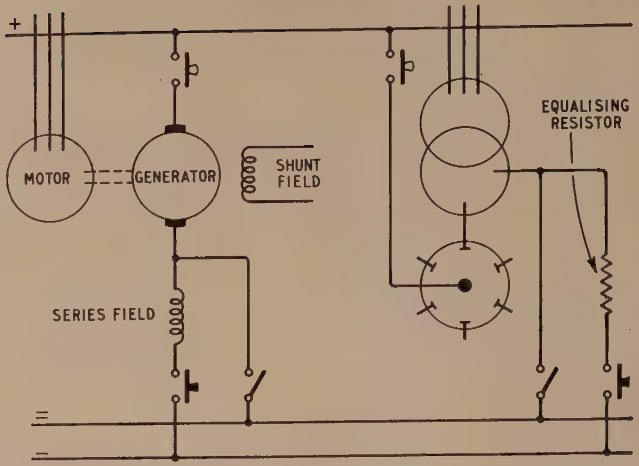


Fig. 7.—Parallel operation of a rectifier with a compound wound generator. Voltage drop across series field is matched with that across equalising resistor and sharing is thus controlled by series field current

The parallel operation of mercury arc rectifiers within an equipment is achieved by using either divided windings or anode reactors. For germanium and silicon rectifiers the cells are usually slightly derated and operated in parallel without dividing reactors. Complete rectifier equipments may also be operated in parallel with each other or in parallel with machines with a drooping voltage/load characteristic without difficulty by matching their characteristics. When it is necessary to operate a rectifier in parallel with a level compounded generator an equalising resistance has to be used as shown in Fig. 7. In this arrangement the voltage drop across the resistor at full load is matched with the voltage drop across the series field winding and the control of the current in the series field by this means provides sufficient voltage control of the generator to ensure reasonable load sharing.

Protection

With any make or type of rectifier there is a current limit, a voltage limit, and a temperature limit above which backfires or cell failures will occur with great frequency. British practice is to operate well within these limits, nevertheless the possibility of such occurrences must be taken into account when arranging the protection. The effect of a backfire or cell failure is to put a short-circuit on both the a.c. and d.c. systems as shown in Fig. 8.

Mercury arc rectifiers are also susceptible to arc starvation troubles and other faults when an attempt is made to operate them at too low a temperature or when the temperature differentials inside the rectifier vessel are incorrect. This is particularly so in the case of rectifiers with wide-range grid control of voltage or when the operating duty is severe and for these a minimum rectifier vessel operating temperature of about 20°C with careful control of temperature differentials is necessary.

Selenium-iron rectifiers have a fairly high forward resistance and do not require extra reactance in the circuit for fault limitation. Both germanium and silicon rectifiers have a negligible forward resistance and a very low thermal capacity in the rectifier cells. Depending on the speed of the protective device (unless the risk of destruction on short circuit is accepted) they need either a large amount of reactance in their supply to limit the prospective short-circuit current or must be derated. All semiconductor rectifiers are sensitive to voltage surges and this is particularly so in the case of germanium and silicon which have a voltage withstand limit in the range 1·5 to 2·5 times their rated crest working voltage.

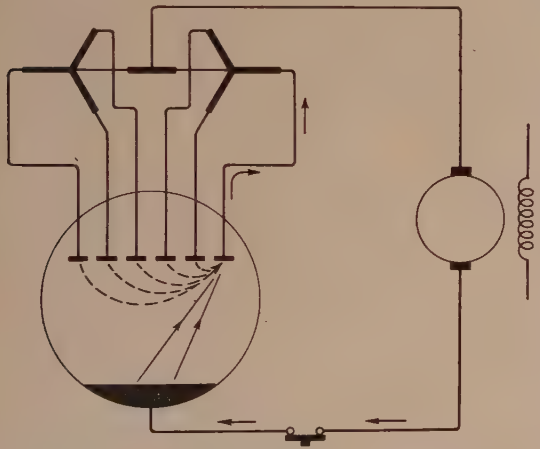
Any system of protection must take these facts into consideration together with the needs of the application and the fault capacity of the a.c. and d.c. systems. Complete inverse time/over-current protection is difficult to achieve and is often omitted, but fault protection is always necessary.

In the case of mercury arc rectifiers the speed of operation of the a.c. and d.c. protection and the amount of reactance included in the circuit must be co-ordinated so that the peak fault current and its duration during backfire and d.c. short circuits is limited to within the fault capacity of the rectifier and transformer. In a large equipment with a number of rectifiers in parallel this may involve the use of several high-speed circuit-breakers (total fault clearance time 0·025 sec) and grouping the rectifiers as shown in Fig. 9. This shows eight six-anode rectifiers supplied from a single 12-phase transformer via anode reactors and supplying a rolling mill with armature reversal. A high-speed circuit-breaker is provided for each pair of rectifiers and, because of the low primary backfire fault current with such an arrangement, backfire relays are provided on the d.c. side. Normally the signals from the shunts cancel and the backfire relays remain de-energised, but when a backfire occurs, they add in the affected pair and provide a signal to the relay which then operates and trips the a.c. circuit-breaker.

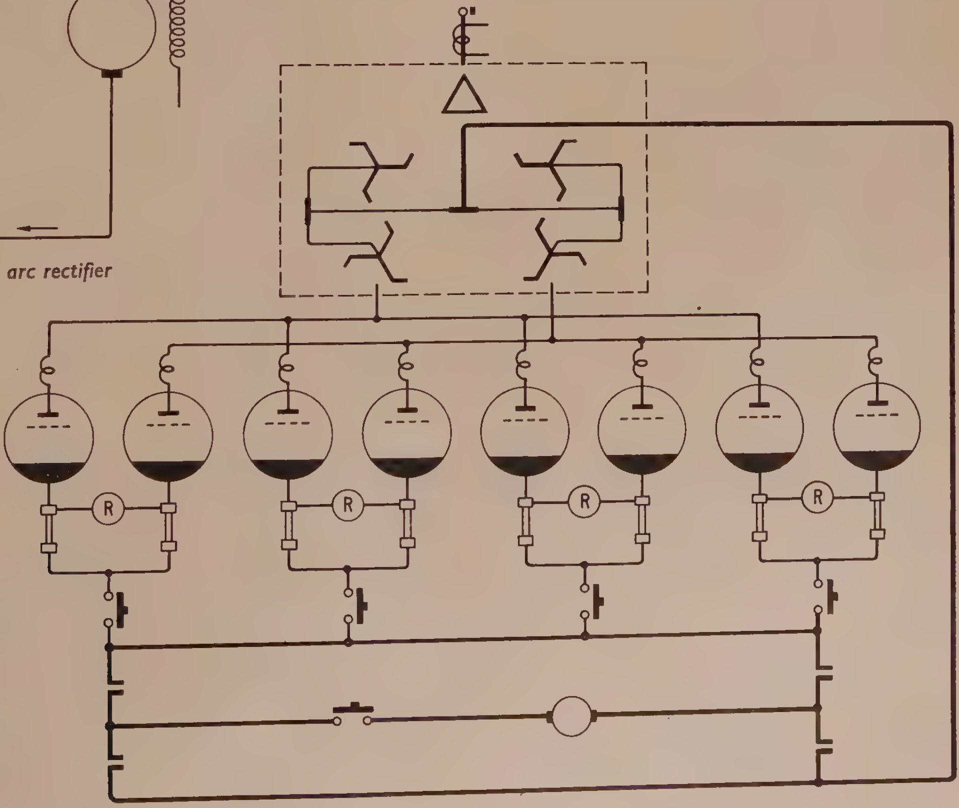
With smaller equipments such a sub-division is unnecessary and a single semi-high-speed (total clearance time 0·025 to 0·06 sec) or medium-speed (clearance time in excess of 0·06 sec) circuit-breaker may suffice. Unless anode fuses are included, which is rare with steel tank rectifiers, instantaneous fault tripping of the a.c. circuit-breaker must be included.

Arc suppression is also used as a supplementary protection in some of the larger and more important installations. This involves the application of a negative bias to the control grids in the event of a fault, thus preventing subsequent anodes from feeding into the fault. Its effectiveness depends a great deal on the speed at which the negative bias is applied to the grids, and schemes have been devised to do this within 1 to 2 millisec from the commencement of the fault. It should, however, be borne in mind that arc suppression is not a substitute for the more conventional forms of protection. It inherently cannot fail to safety and it cannot interrupt any d.c. feed-back during backfire. Nevertheless, when used, it serves to limit voltage stresses and fault ampere seconds and permits a faster circuit reclosure after a fault. Surge protection must be provided with all mercury arc rectifiers to limit any possible arc starvation surge voltages to within the surge strength of the equipment.

In the case of semiconductor rectifiers a similar co-ordination of protection is necessary. With germanium and silicon rectifiers the protection must operate fast enough when a cell fails to prevent damage to the remaining healthy cells, and cell fuses are invariably necessary in the larger equipments. Surge protection is always necessary and care has to be taken to avoid the production of excessive surge voltages when clearing faults. For example, the voltage produced across a cell

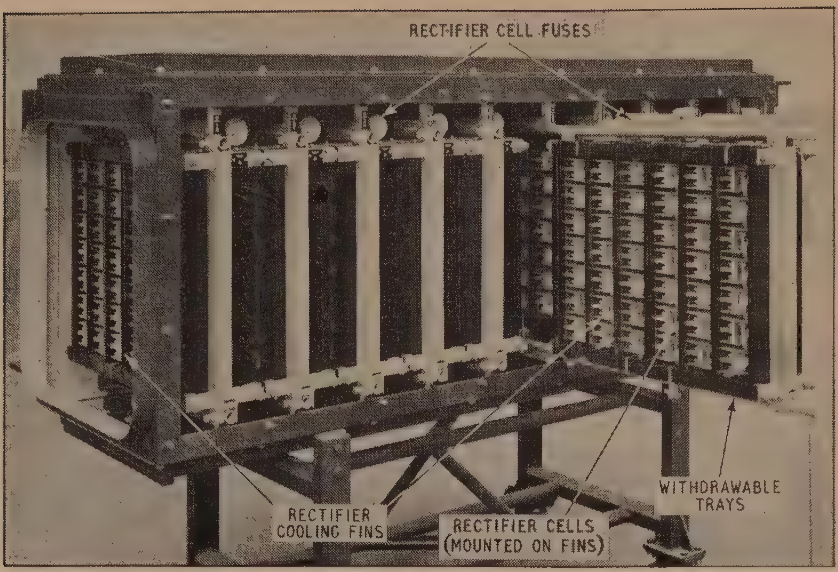


Above: Fig. 8.—Backfire in a mercury arc rectifier driving a motor



Right: Fig. 9.—Typical arrangement of protection for a large number of mercury arc rectifiers controlling a reversing mill drive

R = Backfire relay.



A 682·5 kW 975 V germanium traction rectifier for underfloor mounting on a motor coach

fuse when clearing a faulty cell must be below the voltage breakdown limit of the remaining cells otherwise a single cell fault could cause the failure of the complete equipment. Primary fuses are usually sufficient with selenium-iron rectifiers.

In some rectifier applications, such as traction, it is necessary to ensure continuity of supply and the arrangement of the equipment and protection must ensure the necessary fault discrimination. Other applications may require a faster fault clearance time than that necessary solely for rectifier protection. For example, in a mercury arc rectifier controlled d.c. motor winder drive, the speed of operation of the d.c. protection is often determined by the need to limit rope slip and mechanical stresses and not by the fault capacity of the rectifier.

Auxiliaries and Interlocks

It is general practice in large rectifier installations to provide electrical interlocks to ensure that all auxiliary circuits, i.e. fan or water cooling circuits and (for mercury arc rectifiers) excitation and temperature control circuits, are healthy. Rectifiers with voltage control for motor starting also need some form of interlock to prevent full voltage being applied to a stationary machine. Grid controlled mercury arc rectifiers usually need an interlock or the controls so arranged to ensure that the grid circuits are energised before the d.c. circuit-breaker is closed. When thermostats are used with mercury arc rectifiers it is usual to take their signals away via insulating transformers.

The same rules for fittings should be applied to rectifier transformers as to normal power transformers (see B.S. 171:1959). The use of oil conservators, breathers and Buchholz relays should also be considered, even when not covered by these rules, when the operating duty is severe, such as in a rolling mill or winder drive. A Buchholz relay provides a sure indication of incipient insulation failure and the conservator and breather combine to slow down oil deterioration and sludging.

When applying rectifiers to traction systems and industrial loads it must be borne in mind that unless they have been designed for inversion duty, which is only practicable with mercury arc rectifiers and for few applications, they cannot accept reverse power. If regeneration occurs when no other load is on the system to absorb it a rise in busbar voltage will occur. If the regeneration is caused by a sudden change in motor field strength the initial surge voltage resulting from the regeneration could cause motor armature flashover or insulation failure. A method of applying a loading resistance to the busbars fast enough when regeneration occurs to prevent any dangerous rise in the d.c. system voltage is shown in Fig. 10. In this arrangement the busbar voltage is compared to a reference voltage and when it exceeds this by a pre-set margin the grid of the thyratron is driven positive, thus permitting the thyratron to fire the main ignitron, which immediately places a loading resistance across the busbars. Once the ignitron has fired the relays take control and remove the loading resistance when the busbar voltage returns to normal.

The installation and ventilation of rectifier equipment present no serious problems although the low-temperature limitations of mercury arc rectifiers must always be kept in mind. Elaborate buildings and foundations are unnecessary. Most rectifiers are air cooled and forced ventilation of the rectifier room or the provision of special air ducting may be necessary with the larger equipments, but the smaller units can usually draw in sufficient cooling air for their needs without greatly influencing the overall building temperature.

For special applications, for example, installations in a corrosive or very dirty atmosphere, it is advisable to provide a completely sealed rectifier with its own air

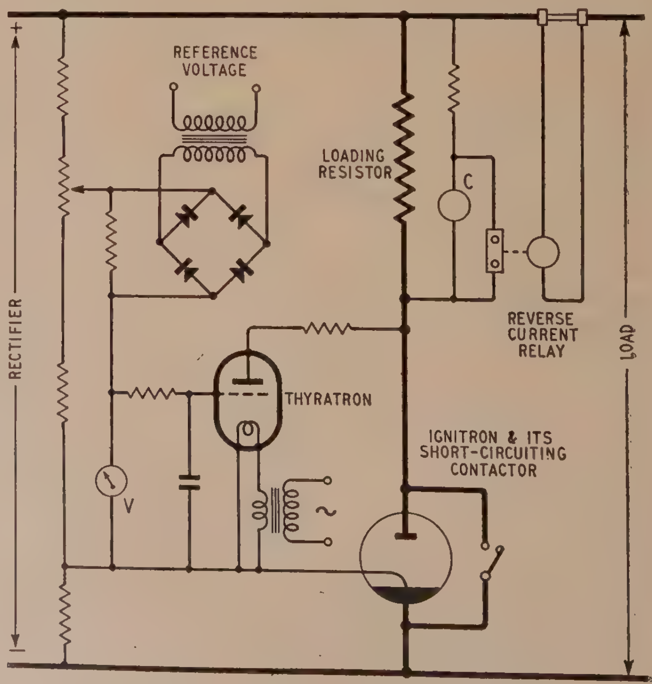


Fig. 10.—Basic circuit for ignitron loading equipment

circulator and air-to-water heat exchanger. This is easier to provide with semiconductor rectifiers. For very large ratings under such conditions a still better arrangement—although more expensive in building costs—is to provide the complete rectifier room or substation with a closed air circulating system.

Rectifier transformers should be treated like comparable-sized power transformers. Units containing more than about 200 gallons of oil should preferably be housed in separate outdoor cells over oil-soaking pits.

With the exception of the anode cables to mercury arc rectifiers standard cabling practice may be used. The anode cables to mercury arc rectifiers have to be able to withstand fault currents which may be up to 60 times their normal r.m.s. rating and occasional high-voltage surges caused by arc starvation and should be designed to suit these conditions.

The author wishes to thank the management of the A.E.I. Heavy Plant Division for permission to publish this article.

NEW BOOKS

The Modern Slide Rule. 3rd Edition. By Dr. R. Stender and K. K. McKelvey. Pp. 119; figs. Cleaver-Hume Press, Ltd., 31, Wright's Lane, London, W.8. Price 6s.

The third edition of this established book is the result of co-operation between the original author Dr. Stender, who is primarily a mathematician, and Mr. McKelvey, who is a civil engineer. There are three main parts, the first explaining the working of the slide rule, the second illustrating its application to problems in engineering and other fields and devoted mainly to the log log and special scales, while the last comprises a large number of examples. Although simple enough for the beginner, the manual reaches a sufficiently high standard to be of particular value to the increasing numbers of students using slide rules in technical colleges and universities.

Basic Mathematics for Electronics. By Nelson M. Cooke. 2nd Ed. Pp. 679; figs. McGraw-Hill Publishing Co., Ltd., 95, Farringdon Street, London, E.C.4. Price 58s.

The title of the first edition of this American text, published in 1942, was " Mathematics for Electricians and Radiomen " and, in a broad sense, it is still to such men that the new edition is directed. However, and as the author points out, specialisation has compelled the so-called " radioman " to restrict his activities so that today he is a communications specialist and " he and the formerly electronics-oriented electrician have been replaced in the technical portion of the field by the highly specialised electronics technician, whose skill and knowledge may approach those at the engineering level." That, at least, is the picture in the U.S.A. and it is not very wide of the mark in Great Britain so far as electronics technicians are concerned.

There are no fewer than 37 chapters in the book and an appendix of eight sets of miscellaneous tables related to the main text. The range of subjects is from simple arithmetical addition and subtraction to ordinary and complex-vector algebra, Ohm's and Kirchhoff's laws in series and parallel circuits, trigonometric and periodic functions, alternating currents in series and parallel circuits, exponents, simultaneous and quadratic equations, and a number of other topics pertinent to the general subject. All these are discussed in most meticulous detail and there is a profusion of everything in the book—worked examples, problems (with answers to half of them), illustrations—circuit diagrams, vector diagrams, graphs, line drawings and half-tones, tables, and a nine-page index. Typesetting and draughtsmanship of the illustrations could not be bettered and there are wide margins to the pages and distinctive and attractive covers.

The present edition is virtually a new book, mainly on account of thorough revision and expansion of the original work but also due to the inclusion of new matter on the basic operations in arithmetic, meter circuits, and voltage-divider circuits, and to the great majority of the problems being new. Wherever possible, mathematical concepts and processes have been related clearly and directly to electrical and electronics applications of a severely practical nature, with considerable advantage to the reader.

In Great Britain this book should be a great help to students and teachers of City and Guilds courses for telecommunications technicians and electrical technicians and of the S1 and S2 years of the O.N.C. courses in electrical engineering. It is also admirable for self-teaching where circumstances dictate such a course.—A.E.

The Fifteen Wonders of the World. By R. Piorier. Pp. 400; illus. Victor Gollancz, Ltd., 14, Henrietta Street, Covent Garden, London. Price 25s.

This book for young people gives details of 15 of the major engineering feats in history, ranging from the Tower of Babel to the Oak Ridge atomic power project and including the transatlantic cable, the London Underground and the Volga and Tennessee hydro-electric dams. Non-electric undertakings described include the Great Wall of China, Roman roads, the Eiffel Tower and the reclaiming of the Zuyder Zee.

BOOKS RECEIVED

The Dielectric Circuit. By P. Kemp. Pp. 219; figs. Chapman & Hall, Ltd., 37, Essex Street, London, W.C.2. Price 45s.

Basic Synchros and Servomechanisms. Part One. Pp. 119; figs. Part Two. Pp. 112; figs. Technical Press, Ltd., 112, Westbourne Grove, London, W.2. Price 16s each part.

Electronic Equipment Reliability. By G. W. A. Dummer and N. Griffin. Pp. 274; figs. Sir Isaac Pitman & Sons, Ltd., Pitman House, Parker Street, Kingsway, London, W.C.2. Price 45s.

Silicones. By S. Fordham, Ph.D. Pp. 252; figs. George Newnes, Ltd., Tower House, Southampton Street, Strand, W.C.2. Price 36s.

Two Hundred Precious Metal Years. By Ronald E. Wilson. Pp. 316; figs. Ernest Benn, Ltd., Bouverie House, Fleet Street, London, E.C.4. Price 63s.

VIEWS on the NEWS

By "REFLECTOR"

ELECTRIC space heating is not regarded in this country as a very useful load although the Electricity Boards have to accept it. On the other hand electric "utilities" in the United States have been actively fostering it as a seasonal counterbalance to the huge summer air-conditioning demand. Perhaps our summers are not so encouraging, but it seems to me that we might employ the American technique in reverse: that is build up a summer air-conditioning load to help to even out the load curve. Those who have attended functions in most public places in July and August can testify to the need for air-conditioning.

* * *

Southern Electricity quotes a queer story from an Australian newspaper. One of the Australian State Electricity Commissions (it is not stated which) has demanded that electricity consumers with outside meters shall provide permanent paths upon their property to give easy access to meter readers. As an alternative they may have their meters moved to a more accessible position—at their own expense. This has been described as "Gilbertian"—a mild way of putting it. Presumably the supply authorities themselves put the meters where they are and so they should move them without cost to the consumers.

* * *

Mr. G. D. Leydon in a letter to the *Electrical Power Engineer* deprecates attempts to compare the duties of engineers at C.E.G.B. headquarters with those of project group site staff. He contends that while on the whole the technical responsibilities of the man at H.Q. are greater, the site engineer's responsibilities are unlimited. He puts the difference very well by saying:—

> "Whilst the H.Q. engineer is solving his heat transfer problem the site engineer is deriving a formula for reduction of friction between two contractors' agents and for every law of pumping design the good site engineer can quote a building regulation with one or two C.E.G.B. safety rules thrown in for good measure."

* * *

I was surprised to read in the *Evening Chronicle* (Manchester) that "the North Western Electricity Board's substation at The Circuit, Alderley Edge . . . is continually belching thick, grimy smoke over the area." This looked like a bad case of overloaded transformers, but reading on I found a reference to the engines going at full blast. Referring to the Central Electricity Generating Board's last report I found that this so-called "substation" is actually a 4 MW i.c. generating plant in the North West, Merseyside and North Wales Region; it does not belong to the Area Board.

* * *

Because the South Wales Electricity Board has laid down conditions to ensure an adequate return upon the cost of supplying electricity to new housing estates it is accused of "commercial blackmail" by the Caerphilly Urban Council. After comparing the proposals unfavourably with the terms offered by the Gas Board, the Council's surveyor said, as reported by the *Western Mail*, that "at least the Electricity Board can be assured that their supplies will be used for lighting." That is just the point.

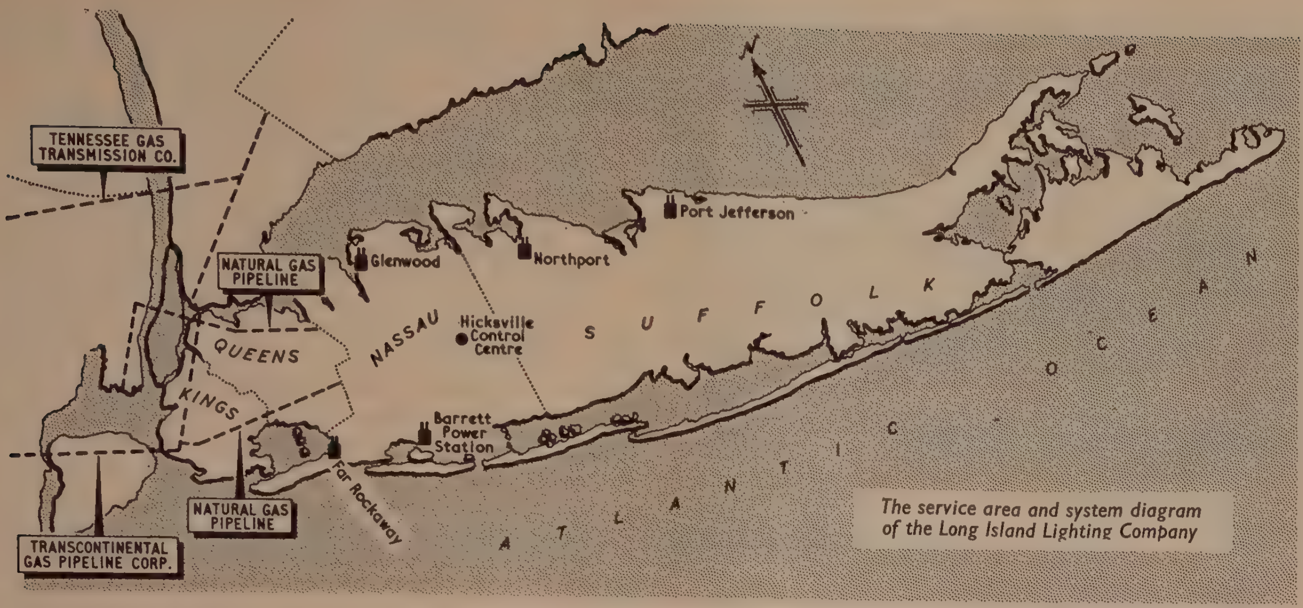
* * *

I suppose that it is possible to criticise some features of the advertisements of the Central Electricity Generating Board but I think it is going a bit far to describe them, as a correspondent of the *West Sussex Gazette* does, as "untrue, misleading and brainwashing." I am particularly amused by the term "brainwashing" (twice repeated) which raises an image of the members of the Board in sinister conclave devising means of impressing their subversive doctrines upon a captive public.

* * *

Half a century ago the electricity supply authorities were making great efforts to build up a load to compensate for the large reduction in consumption brought about by the introduction of the metal-filament lamp, as well as to balance the predominant lighting load by encouraging daytime use. The *Electrical Review* of 30th December, 1910, said:—

> "We have observed with great satisfaction during the past year the enterprising efforts of electricity works authorities in a number of places to prove beyond a shadow of doubt that nowadays the old and once sceptically regarded cry of electricity being the "poor man's light" is absolutely true. If we could only simplify the problem that is presented by the gas cooking stove, which came so opportunely to the help of the gas companies, so that electricity could be economically employed in the average household for all purposes, electricity would advance by bigger leaps and bounds than ever before. The greater attention that manufacturers of heating and cooking apparatus and station engineers have been devoting to this department of the industry during 1910 encourages a hopeful view as to an early issue of importance in this connection, especially bearing in mind that electricity supply authorities are simplifying their charging systems for the convenience of the man who wants to adopt electricity for all purposes through one service at a uniform or contract price."



The service area and system diagram of the Long Island Lighting Company

LONG ISLAND SUPPLY SYSTEM

By J. J. ROONEY

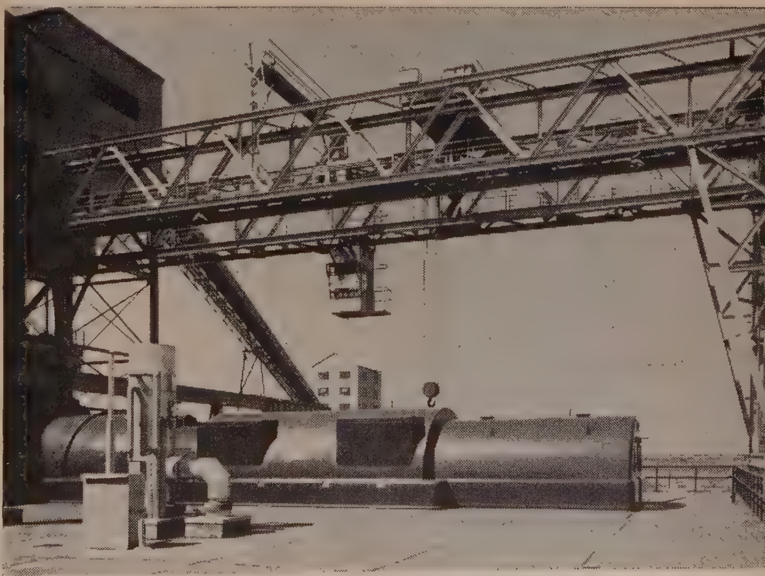
The operation of the Long Island Lighting Company in the State of New York is described. This company is responsible also for supplying gas, and this fuel is now being used in electric power stations. Recent power station construction has employed outdoor type turbines and boilers

ONE of the most highly developed areas in the United States is Long Island. This 120 mile long stretch of land reaching from New York City's Manhattan Island to Montauk Point is part of the State of New York and is composed of four counties, two of them being boroughs of New York City (Queens County and Kings County or more familiarly—Brooklyn). Nassau and Suffolk Counties, with a population of 2 million, form the eastern part of Long Island and contain about 1,230 square miles of the 1,393 square miles that make up the area of Long Island.

Long Island Lighting Co. (LILCO) serves the area of Nassau and Suffolk Counties and the Rockaway Peninsula of Queens County. Total number of electrical customers the utility serves is 596,123, and its gas customers number 338,222. In 1940, the population of Nassau and Suffolk Counties was 603,947 and the area was a combination of quiet urban and rural communities.

With the outbreak of the 1939-45 war many light industries sprang up and developed there, bringing more stores, shopping centres, schools, churches and all the other amenities that go to make the American way of life. Even so, Suffolk County today is still the leading agricultural dollar earning county in the north-east United States. The post-war years brought even greater prosperity and expansion to Nassau and Suffolk, to such an extent that the population in October, 1960, was over treble what it was pre-war. Keeping pace with this development has been the task of LILCO.

Like most other public utilities in the U.S.A., LILCO is operated as a private company (that is, investor owned and taxpaying) responsible for the supply of both electricity and gas within an area of 1,230 square miles which stretches over 100 miles from New York City's eastern boundary to



The 185 MW outdoor type turbo-generator at the E. F. Barrett power station, Long Island. This set was commissioned in November, 1956. When completed, the station will accommodate six such units

The system operations control centre at Hicksville. The substation metering and remote controls are shown on the left. In the centre background, the system operator is on the load control console, while part of the system schematic diagram can be seen on the right

Montauk and Orient Points. The amalgamation of these industries adds considerably to the operating efficiency of both.

The cost of electricity in 1959 was 10 per cent lower than in 1940 even though the cost of living increased by 102 per cent in this period. This remarkable achievement is principally due to increased sales along with higher generation and operating efficiencies. During 1959, the amount of electricity consumed was 4,180 million kWh or 286 per cent greater than it was 10 years previously. (This growth rate, 14·5 per cent, is about double the average for the industry as a whole in the U.S.A.) Generating capacity was increased over 350 per cent in this period, to 1,256·5 MW in 1960. A 138 kV double circuit underground cable interconnection capability of 300 MW is also maintained with Consolidated Edison (the company supplying New York City), which is itself connected in turn with other supply companies on the eastern seaboard. This has proved to be a big mutual asset to LILCO and Consolidated Edison due to the fact that their respective peak loads usually occur at different times.

The boom period in the post-war years brought unprecedented demands for electricity. A major development programme was then undertaken which during the period 1945–60 has cost approximately $400 million.

Natural Gas

During this period, other plans were being carried out a few thousand miles away deep in the heart of Texas and Louisiana; pipelines started creeping eastwards and northwards towards the State of New York and, by 1950, the supply of natural gas reached Long Island. This cheap fuel has proved to be a great boon, not only to LILCO but to the many otherutilities who have made use of it. Today, all the gas mains and appliances on Long Island have been converted from 537 B.Th.U. manufactured gas to take this 1,000 B.Th.U./cu ft natural gas.

Boiler plants at two of the major power stations then being developed were designed to burn natural gas as well as the coal and oil already available. The use of surplus gas for the generation of electricity allows the gas system to operate at 100 per cent load factor. This gas is now purchased from the Texas Eastern Transmission Co., Transcontinental Gas Pipeline Corporation and Tennessee Gas Transmission Co., on a daily allocation basis, at present 120,570,000 cu ft/day. With power stations designed for multi-fuel operation, this not only means that bargaining methods can be used in fuel purchase, but it also ensures continuity of supply in times of trade disputes, as well as allowing an economic choice of fuel.

Power Stations

Many new features were embodied in the construction of recently developed power stations. The use of outdoor type turbines and semi-outdoor boilers not only speeded up construction work (building volume being reduced to 11 cu ft of enclosed space per kW) but it also proved to be a most economic type of installation saving approximately $4/kW, principally through the omission of the huge turbine rooms.

The first 100 MW hydrogen-cooled reheat unit of the semi-outdoor type was commissioned at Glenwood Landing in 1952. It was the first one to be installed at this latitude in the United States (hitherto the climate not being thought suitable for such a venture). The possibility of the unit being buried in snow was overcome by having the surrounding floor area electrically heated. A portable canopy can be easily erected during periods of overhaul if necessary. The success of this installation can be ascertained from the fact that all turbines since installed by LILCO have been of this type.

Control Centre

Hicksville control centre, which is one of the most modern in the United States today, being the first of its type to be installed there, was commissioned in 1953. It is situated near the load centre of the system, in the Hicksville Operating Headquarters. Due to the close proximity of strategic air-raid targets, the bomb-resistant control centre is situated underground.

From the circular, air-conditioned, sound-proof, control room, specially protected telephone cables radiate to all generating stations, major substations and gas plants in the system. This makes available to the operating staff the following principal control functions:

Supervisory control of remote substations: Up to 40 major substations can be operated from the control centre by supervisory equipment. At present, 35 stations are actually under control. Supervisory equipment for each station operates over a single pair of telephone wires to control circuit-breakers, disconnect switches, change transformer tappings, telemeter remote voltage and current values, facilitate synchronisation across remote breakers, show position of remote equipment and report various alarm functions at remote stations.

Automatic load control: Power flowing from all the major generating stations and through the interconnection with the neighbouring utilities is automatically controlled from a load control console, which is under the supervision of the system operator. By pre-setting the automatic controls, any required load can be maintained through the interconnection, at the same time regulating the effect of any variation in the (LILCO) system load. Control impulses are triggered to the governor motors at the generating stations, varying the output as required, this being governed by a frequency master controller. The operator can schedule all load change to fall on any one station, or bias both the rate and proportion of any system load change among them, such as may be dictated by economic load conditions. Normally, the entire load is under automatic control but the system operator can take over and regulate by hand control if necessary. In times of serious system disturbances, automatic controls are tripped off, leaving each station to operate individually. Power station control operators can supersede all automatic control functions at any time.

Weather instrumentation: Because the control centre is underground, an illuminometer has been installed to measure and record daylight intensity. This gives the system operator an indication of an early twilight which may cause an early peak, or heavy clouds which increase daytime loads. Furthermore, weather information and forecasts are received on teletape, teletype and facsimile charts from the United States Weather Bureau. Temperature, humidity, wind velocity and speed are also recorded in the control centre.

Consumers' Service

A first-class consumers' service is maintained from the same building, immediately above the Control Centre, radio contact being maintained with operating centres and emergency trucks. During adverse weather conditions or hurricanes, the last one of which was experienced in September, 1960, an adjacent room which is equipped with 60 emergency telephone stations can be manned by office staff. Emergency services are considered very important features indeed, because 96 per cent of the transmission and distribution system is overhead.

Future Planning

To handle the requirements of Long Island's expanding economy, the electrical and gas facilities are planned from a long range point of view under the direction of a planning committee. Aerial photography is used to give a "bird's eye" view of development and an a.c. network analyser to test the theories.

During this year, a further 185 MW unit was commissioned at the Port Jefferson station. Work has already begun on an additional generating unit at the Barrett station due for completion in 1963 and a further generating station is planned for a 250 acre site at Northport to be developed in the mid 1960's. The problem of storage of large quantities of natural gas on Long Island is being studied. This gas would be stored during off-peak seasons for use during the winter months.

Atomic Research

An interest in atomic energy research is maintained through active participation with other companies in the Enrico Fermi 100 MW fast breeder reactor now under construction near Detroit. However, the use of atomic energy for electric generation on Long Island still appears to be many years away, unless some significant technical advance materially reduces the present high cost of installation and operation of such a plant.

Transformer Manufacturers' Agreement

The Restrictive Practices Court is considering whether a price-fixing agreement between members of the Transformer Manufacturers' Association is in the public interest.

Mr. John Megaw, Q.C., continuing his final address for the Registrar, said that the effect of the agreement was to enable members of the Association to charge higher prices for large transformers in which they had a monopoly and to use some of their profits from large transformers to subsidise their price war in small transformers with non-members. By means of the collective rebate given to Area Electricity Boards who bought small transformers from members, the Association were trying to win business in small transformers from the non-members who on the evidence were more efficient in the production of certain types of small sizes in which they specialised. The larger manufacturers ought to concentrate on the manufacture of larger and medium transformers and leave the production of small transformers to non-members whose factories were laid out and adapted for that purpose. It was the Association's attempt to distort that natural division of economic production that had been responsible for the drop in prices of small transformers. There was no reason to suppose that if the agreement were abrogated the same violent fall in the prices of small transformers would occur with large transformers because the conditions were not similar, that is, there was no clubbing together of inefficient makers of large transformers to kill outside competition.

The prices fixed under the agreement were based on costings which were wholly unsatisfactory. Even if restrictions were justifiable to protect the industry from adverse consequences of price competition, the restrictions in this agreement could not be supported because it was apparent that the costings did not provide a proper basis for fair and reasonable prices. There was no common costing system: members treated design rates for transformers differently in their costs, there were differences in the quantities of material charged for the job, and there were differences in the allocation of overheads. They had refused to disclose their costings to the electricity supply authorities so as to satisfy the authorities that their prices were reasonable, and although prices were based on the average of the three lowest costs returned by members, there were cases of extreme variation even between the lowest and the second lowest cost producer. The Association had relied on the modest level of the overall profits of their members, but that was misleading because it included profit on small transformers where there was price competition. Looking at the profits made on large transformers, it appeared that they were high, and it was in those profits where the Association was the monopoly seller that the Court should be interested. Profit figures could also be misleading in this case because it was not possible to ascertain what was the profit in relation to the capital employed.

The Association's case was that without the agreement there would be a severe price war, leading to loss of quality in transformers, to reduced expenditure on research and development, to the imposition of unfair prices by the supply authorities, and to reductions in exports. The whole argument rested on the unfounded concept of a potential price war. Although prices would fall were the agreement to be ended, there was no reason to think that price reductions would be severe or that there would be a period of prolonged uneconomic prices. This was an industry where there had been a steadiness of sales to the value of £23 million to £24 million year after year, where there had been an average rise of capacity of between 83 and 86 per cent between the years 1955-59, an industry in which there had been a remarkable lack of fluctuation in demand. Moreover, the trend of orders at the present time was upwards and there was every prospect that such excess capacity as there was would be absorbed in the near future.

Price War Fears Unjustified

The conditions for the violent price war did not exist and the fears of such a price war were unjustified. The tables presented to the Court disclosed that members were still making a profit on the sales of large transformers in the export markets, so that even if home prices fell to the level of the low export prices they would still be economic. All the evidence was to the effect that export prices were rising and were likely to continue to rise.

Even if there was a price war it was unlikely that any members would reduce the quality of their transformers or retrench on research and development. If they wished to remain competitive when there was a price war, there would be all the more incentive to get ahead in technological progress and produce better and cheaper transformers. Price competition would stimulate members to spend more on research and pay more attention to quality because the more efficient manufacturers were able to take advantage of any technical improvements they made by reducing their prices, so taking a greater share of the market.

The argument that the agreement was necessary to negotiate fair prices with the Central Electricity Generating Board as the preponderant buyer controlling the market was unsound. The export market had also to be considered and there was no evidence that the C.E.G.B. controlled or was the preponderant buyer in the world market. The evidence was that the Board invited tenders before placing contracts and selected the most suitable tender, but once a tender had been invited there was no bargaining by the Board so as to reduce prices. It was therefore quite wrong to suggest that protection was required from the imposition of unfair prices by the Board, because the Board neither controlled the market nor did it negotiate prices. In any event, the agreement was not necessary to negotiate fair prices, because the prices fixed under it were not fair, being unrelated to the costs of the most efficient producer and based on a costing system that was defective.

It was also said that an unstable home market would lead to a loss of exports because keen competition would force export prices to so low a level that members would not be willing to obtain export orders or, alternatively, because if there were price competition members would cease the exchange of technical and commercial information about foreign markets. But in face of the trend of rising export prices and rising world demand the first reason was untenable and it was unreal to expect that responsible manufacturers would cease to exchange information, if it was of any value to them, solely because the agreement had been ended. There was evidence that responsible local authorities in South Africa, Australia and Pakistan had complained of the practice of level tendering and it was clear that level tendering was intensely disliked abroad. In one case, the Snowy Mountains hydro-electric scheme, the dislike went so far that manufacturers were informed that if their practices were restrictive of free competition, their tenders would be rejected. Owing to the agreement exports had been lost and the agreement far from winning exports had impeded them. The Registrar asked the Court to take the same view as the Monopolies Commission—that the system of common prices operated against the public interest.

Mr. B. J. M. MacKenna, Q.C., beginning his final address for the Association, said that the agreement was necessary to protect manufacturers from the power of the monopoly buyer of large transformers, the Central Electricity Generating Board, of driving prices down to uneconomic levels. The fact that it had not exercised its power in that way in the past was irrelevant; so long as the Association reasonably required protection against possible abuse of its position by a preponderant buyer, restrictions in an agreement could be justified under the Restrictive Trade Practices Act, 1956. The Act assumed that manufacturers might not be strong enough individually to resist the temptation of selling too cheaply when faced with a powerful buyer who controlled the great bulk of the large orders placed with the industry. The manufacturers were therefore permitted to combine to prevent what could not be done individually—that was, prevent sales at unreasonable prices.

Were the agreement to be abrogated there would be a severe price war. The evidence of the trade was to that effect and the Association's economist had given seven good economic reasons why it would occur. They were the fact that demand for transformers was variable and might, as at the present time, exceed capacity, there was the insensitivity of demand to changes in price, the inability to use transformer factories for other purposes when demand was reduced, the fact that transformers were built to specific requirements, the inability to produce transformers for stock, the system of tendering by which orders were placed, so that a manufacturer did not know how low his competitor's price was, and the predominance of one particular buyer. All these factors would combine to produce a severe price war were the agreement to end.

Mr. MacKenna had not concluded his final address when the hearing was adjourned to 11th January, 1961.

ATOMIC EXHIBITION

A photographic exhibition devoted to the peaceful uses of atomic energy is being held by Ilford, Ltd., at Ilford House, Oxford Street, London. The exhibition, staged with the co-operation of the United Kingdom Atomic Energy Authority, is in nine sections. Seven photographic sections deal with the work of the U.K.A.E.A. including research, electrical power production, isotopes and reactor fuels. The eighth section is devoted to two models, a Geiger counter and a working remote handling apparatus. The operation of a Calder Hall reactor is demonstrated by a working model while the other model depicts the Dounreay fast reactor. The final section shows the use of Ilford emulsions for nuclear research. These emulsions are used to detect single charged nuclear particles and are bound sheet-upon-sheet into a stack.

The exhibition was recently opened by Sir Roger Makins, chairman of the U.K.A.E.A., and will remain open until about mid-February.

Admission to the exhibition, between 9 a.m. and 5·30 p.m. daily (Thursdays to 7·30 p.m.), is free.

INDUSTRIAL NEWS

Increase in Bulk Supply Tariff

THE Central Electricity Generating Board state that they reluctantly find it necessary to make an overall increase of approximately 2½ per cent in their bulk supply tariff charges, under which electricity is sold to the Area Boards, for the year commencing 1st April, 1961. The Board "are pursuing their declared policy of progressively providing an increasing proportion of their capital needs from internal resources. They have also taken account of increased costs, including wage and salary awards and interest rates."

The change will involve a 3½ per cent increase on the normal fixed charge per kilowatt of maximum demand, raising it from 142s to 147s, and a 2½ per cent increase on the basic running charge, raising it from 0·41d to 0·42d per kWh.

There will be no alteration in the coal clause adjustment factor of 0·00055d/kWh for each penny by which the fuel cost per ton in the year shall be above or below sixty shillings.

The increases are interim adjustments pending a comprehensive review of the structure of the tariff, and do not imply any change in the long-term trend towards a decreasing running charge, the basic rate for which over the last five years has fallen from 0·5d/kWh. The full schedule is published in an advertisement on page 49.

ENGINEERING WAGE SETTLEMENT

Agreement was reached last week between leaders of the Confederation of Shipbuilding and Engineering Unions and representatives of the Engineering and Allied Employers' National Federation on pay increases for engineering workers ranging from 7s to 8s 6d a week. The cost to the industry is estimated at £60 million a year. The increases date from 26th December and represent an improvement of 1s 6d on the employers' previous offer which was rejected by the unions on 23rd November. The majority in favour of acceptance of the latest offer was 15 to seven.

Mr. J. Matthews, president of the Confederation, said afterwards that the amount "was the best that could be obtained in the circumstances." He added that, now agreement had been reached on basic rates, the Confederation would press for talks on a revision of the industry's wage structure. The original claim was for an all-round increase of £1 a week. With the increases the minimum time rate for skilled men is raised to £9 15s 2d a week; for unskilled men to £8 4s 10d; and for women of 18 and over to £6 13s 6d.

Oil-filled Cables for London

A contract to the value of approximately £1¼ million for the manufacture and installation of some 165,580 yd of 132 kV single-core oil-filled cable and 55,000 yd of auxiliary cables has been awarded to Pirelli-General Cable Works, Ltd., by the Central Electricity Generating Board. These cables will be laid from Holborn to St. Marylebone and from St. Marylebone or Finchley to Mill Hill.

Boards' Sales Analysed

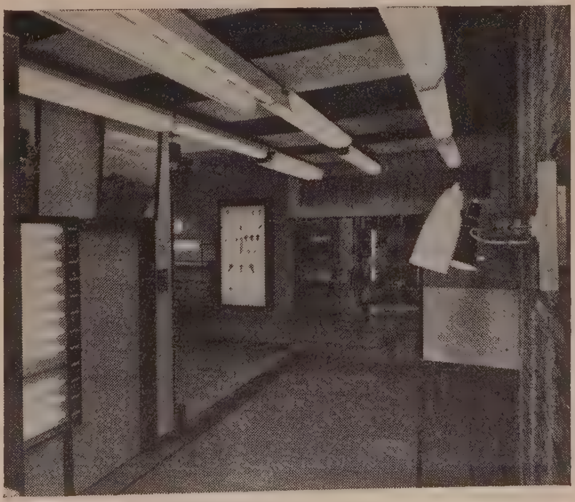
THERE was little to distinguish between mainly industrial and non-industrial Area Boards in the percentage increases in electricity sales in November. The London Board, which had occupied the highest position in October, dropped to last place in December, and the Yorkshire Board led with a gain of 19·3 per cent. For the eleven months to date, the Southern and Yorkshire Boards are now tying with an improvement in sales of 16·4 per cent. For November the national figures issued by the Electricity Council show an increase of 13·1 per cent, but when corrected for weather conditions and working days, the increase is 12·9 per cent.

ELECTRICITY SENT OUT BY BOARDS FOR THEIR CONSUMERS

Board	Totals for November (million kWh)			Twelve Months' Totals Ended 30th November (million kWh)		
	1959	1960	Inc. or Dec. %	1959	1960	Inc. or Dec. %
London	823·3	902·0	+ 9·6	7,967·2	8,864·6	+11·3
South Eastern	546·7	615·1	+12·5	5,493·6	6,255·5	+13·9
Southern	720·3	833·6	+15·7	7,172·0	8,347·3	+16·4
South Western	328·7	370·3	+12·7	3,378·9	3,862·5	+14·3
Eastern	874·6	981·2	+12·2	8,722·6	9,977·6	+14·4
East Midlands*	725·2	803·0	+10·7	7,307·5	8,266·2	+13·1
Midlands*	953·4	1,073·3	+12·6	9,571·1	10,923·6	+14·1
South Wales*	505·7	562·3	+11·2	5,374·0	5,990·7	+11·5
Merseyside and N. Wales* ...	540·4	609·2	+12·7	5,672·3	6,413·6	+13·1
Yorkshire*	897·1	1,070·5	+19·3	9,202·5	10,716·3	+16·4
North Eastern*	512·8	595·6	+16·1	5,384·6	6,073·9	+12·8
North Western*...	899·9	1,036·1	+15·1	9,362·8	10,624·8	+13·5
Total all Area Boards	8,328·1	9,452·2	+13·5	84,609·1	96,316·6	+13·8
Direct Supplies by C.E.G.B. ...	307·9	316·5	+ 2·8	3,380·0	3,780·6	+11·9
Grand Total	8,636·0	9,768·7	+13·1	87,989·1	100,097·2	+13·8
Mainly Industrial Areas* ...	5,034·5	5,750·0	+14·2	51,874·8	59,009·1	+13·8
Mainly Non-Industrial Areas ...	3,293·6	3,702·2	+12·4	32,734·3	37,307·5	+14·0
South of Scotland E.B.	697·7	810·9	+16·2	7,088·4	7,909·0	+11·6
North of Scotland H.E.B. ...	157·6	180·0	+14·3	1,600·6	1,792·0	+12·0

* Those in which industrial consumers took over 50% of the total sales in the preceding financial year.

Lighting Showroom



Part of Atlas Lighting, Ltd.'s, new showroom recently opened at 9/15, Waverley Street, Glasgow

B.E.A.M.A. Explain Electrification Failures

THE British Electrical and Allied Manufacturers' Association, in a statement last week about difficulties experienced in the introduction of new electrified railway services in the Scottish and eastern regions, said that the schemes employed the most advanced techniques under conditions "not paralleled in any other country."

The statement, which was issued on behalf of the electrical manufacturers, said: "We share with British Railways concern at the inconvenience to the public.

"The manufacturers are using all their resources, in collaboration with British Railways, in solving the special technical problems which have arisen.

"The new high-voltage a.c. system has been adapted to British Railways with its densely trafficked suburban and main line services, heavy pollution conditions, and special clearance problems in tunnels and station areas. More than 600 miles of lines have been commissioned on the high-voltage system in two months.

"It is a basic problem of major alterations to railway systems that complex work has to be carried out whilst maintaining full services. The new equipment was extensively tested by the manufacturers jointly with British Railways under trial running conditions, but with so many different factors involved the final proving is only possible when all the new equipment is operating together as one complete system."

The manufacturers and British Railways had every confidence that these particular difficulties would be quickly overcome. "Britain's electrical engineering exports depend on technical progress, and problems of this kind are part of the price to be paid for maintaining our leadership."

RAILWAY REORGANISATION

THE Government's plans for reorganisation of the nationalised transport undertakings were announced last week as a White Paper (Cmnd. 1248, price 1s).

The three main aims are (1) to replace the British Transport Commission and the existing organisations by a new structure designed to overcome the main defects and disadvantages of the present organisation; (2) to reconstruct the finances of the Commission, particularly those of the railways; and (3) to give the various undertakings maximum freedom of operation in commercial affairs.

The financial changes provide for the wiping out of £400 million of railway debt and placing a further £800 million to suspense, thus relieving the railways of some £40 million interest a year. To effect the changes major legislation will be needed but it can hardly come into force before the middle of 1962.

Under the new structure each of the B.T.C.'s main activities will be managed by a separate Board. There will be Boards for the railways and London Transport. On the railways the existing Area Boards will be replaced by autonomous Regional Railway Boards, and regional trading accounts will be maintained.

The aim is that within the next five years the railways should have eliminated their current running loss of £60 million a year and be able to meet their revised interest charges. It is recognised that a railway system "of the right size is an essential element in the transport network and will remain so as long as can be foreseen." It is already clear, the White Paper states, that the system "must be more compact and that there must be modernisation not only of layout, equipment and operating methods but also of organisation and management structure."

Appliance Export Drive by A.E.I.

ASSOCIATED Electrical Industries, Ltd., have formed a new management company, A.E.I. Appliances, Ltd., to direct the domestic appliance business of its two subsidiaries, A.E.I.-Hotpoint and A.E.I.-Gala, with the particular aim of stepping up the group's export sales. Lord Chandos will be chairman of the new company, and Mr. R. Craig Wood, the chairman and managing director of A.E.I.-Hotpoint, will be managing director.

Hitherto A.E.I.-Gala has been the export subsidiary of Hotpoint, but it will now be a direct subsidiary of A.E.I. itself. Hotpoint will continue to be responsible for the domestic appliance business in Britain.

Mr. D. T. L. Rettie will now, as sole managing director of A.E.I.-Gala, Ltd., be in full charge of all Gala operations throughout the world. He is a director of the new company and remains a director of A.E.I.-Hotpoint.

A statement from Lord Chandos pointed out that these changes reflected the importance that A.E.I. attached to overseas business. A.E.I. already had a large share of the British appliance market, and new products would be coming forward to consolidate that share. But it had been decided that exports were of sufficient importance not to be regarded any longer as an off-shoot of the home business. Under the Gala brand name A.E.I. already exports domestic appliances to about 80 countries.

TRAWSFYNYDD CONTRACTS

Aiton & Co., Ltd., have been awarded the contracts for the supply and erection of steam, feed, circulating water, and certain ancillary services for the two reactors now under construction at Trawsfynydd, North Wales. The steam and feed pipework is associated with six heat exchangers per reactor conveying steam to a total of four 145 MW turbo-alternators at 927 p.s.i. and 715°F and 290 p.s.i. and 685°F respectively. The contracts were obtained from Atomic Power Constructions, Ltd., and are worth about £300,000.

Lancashire Dynamo & Crypto, Ltd., has received an order for nearly 400 permanent magnet motors for operating the reactor control rods. The motors will be Class "H" insulated to operate in an ambient temperature of approximately 100°C, and will be operated from a variable frequency supply so as to have a final speed between 0·2 and 0·7 r.p.m.

Proposed Ferranti Scottish Factory

Negotiations are to be entered into between Ferranti, Ltd., and the Planning Committee of Midlothian County Council on the setting up of a factory to cost between £145,000 and £150,000 on a 50,000 sq ft site at Thorniebank, near Dalkeith. Mr. J. McBoyle, the county clerk, who was authorised by the Committee on 14th December to negotiate with Ferranti, said that the factory, which would be provided by the County Council and rented to the company, would employ 300 men and 200 women.

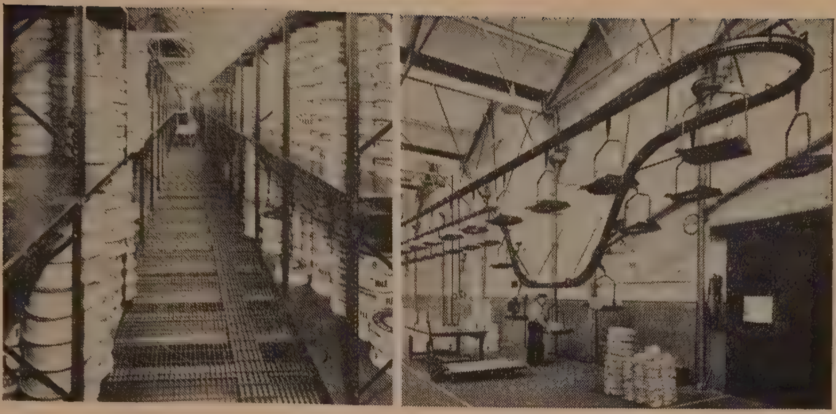
Ferranti is also seeking an agreement with Dalkeith Town Council for the use of the Corn Exchange building in the town until the factory is ready.

MODERN HANDLING SCHEME

UPWARDS of 9,000 sq ft of factory floor space has been freed for productive use by a modern handling scheme in a new warehouse for the storage of light industrial and domestic wiring cable at the factory of British Insulated Callender's Cables, Ltd., at Helsby. The warehouse is in a large covered passageway 200ft long, 40ft wide and 22ft high, in which reels of cable were previously stacked around the walls, using only the first 3ft of free height. Storage capacity has been greatly increased by constructing, at a height of 12ft 5in, a mezzanine floor made from Fisher & Ludlow "Flowforge" open steel flooring with adjustable steel shelving arranged in three double-sided stacks and two single-sided stacks of binning through the length of the store.

Palletised loads can be raised to the mezzanine level by a fork-lift truck or a free-standing lift. A "Flowlink" overhead conveyor, linking the rewinding shop, the packing section, the warehouse and the dispatch department, provides a third method of handling small quantities of goods. It has a continuous track, 300ft long, and 84 tray-type carriers at 5ft 4in centres, each capable of carrying up to 65 lb.

This integrated and flexible handling scheme has not only saved floor space and greatly increased storage capacity, but it has enabled a greater volume of stock to be handled more quickly and with less fatigue by the same storekeeping staff.



A section of the B.I.C.C. warehouse and (right) the "Flowlink" overhead conveyor linking the dispatch department with the warehouse

Showroom Lighting

THE lighting in the Northfield Service Centre of the Midlands Electricity Board was designed by Courtney, Pope (Electrical), Ltd., in conjunction with L. J. Multon & Partners (architects) in association with Mr. A. G. Sheppard Fidler, Birmingham city architect, and the Midlands Electricity Board.

The main lighting in the showroom is provided by a luminous ceiling, utilising 3ft square translucent panels, over which 8ft 125 W fluorescent lamps are positioned. The average level of illumination is 100/125 ft-candles.

The window soffit has recessed tungsten fittings, providing "sparkle" to the merchandise on display, with a combination of 150 W g.l.s. lamps and 85 W MBF/U lamps. The demonstration room has a number of Series 2 recessed fluorescent units with semi-recessed tungsten spotlights, providing an average level of 75 ft-candles.

The main lighting in the M.E.B. Northfield Service Centre is provided by a luminous ceiling

Electronic Signal Interlocking

THE first electronic signal interlocking equipment to be used on British Railways will be installed at the Henley-on-Thames (Western Region) signal box during the early summer of next year. It is being developed by Mullard Equipment, Ltd., under a contract awarded by the British Transport Commission as part of the railway modernisation programme. Until now, interlocking has been effected by mechanical locks or, in more recent installations, by electrically-operated magnetic relays. These will be replaced at Henley by electronic circuits incorporating plug-in "logic" units, embodying transistors, semiconductor diodes and ferrite cores. These units have been designed to operate in ambient temperatures between −20 and +50°C.

Train movements are controlled from a signalman's panel operated in the manner normally used for electric interlocking systems, in which a train route is selected by turning a switch at the point of entry and pressing a button at the exit. The points are set and locked and the signals cleared only if the information fed to the "logic" units shows that the safety requirements for the train movement have been proved. Adoption of this system for future signalling schemes will depend largely upon its ability to surpass the reliability of magnetic relays which can operate for at least five years in a sealed housing and have a failure rate of one in thousands of millions of operations.

Rural Electrification in Ghana

Forty-five towns and villages in rural areas of Ghana are to benefit from an electrification scheme recently initiated by the Minister of Works and Housing. The Government is reported by Barclays Bank D.C.O. as having decided that an immediate survey for rural electrification should be undertaken and a British firm has been invited to carry out this survey. The Minister said that the project would eventually be incorporated into a national electricity network when abundant supplies of power would be available from hydro-electric sources.

Tool Company's Diamond Jubilee

IN 1900 Mr. Sidney Wolfe founded S. Wolfe & Co., of Knightrider Street, London, to import and resell high quality machine tools. Almost as a side-line he began to handle Continental portable electric tools which were sold under the brand name of "Wolf" and so started the present business of Wolf Electric Tools, Ltd. In those early days electric tools were merely electric motors either for a.c. or d.c. (for universal motors were not yet invented) fitted with a chuck, side handles and a switch.

In 1932 a small factory was opened at Kingston and an entirely new range of electric tools under the brand name "British Wolf" was introduced. The success of this project soon justified the building of a new factory, and in 1935 the present head office and factory, Pioneer Works, Ealing, was built. The fact that many of the tools built in those days are still in current use bears testimony to their quality. Soon Wolf electric tools were being successfully marketed overseas.

The highlight of the early post war years was the introduction in 1949 of the "Wolf Cub" range of domestic power tools and equipment. This development opened up a new and fertile market. With a growing demand for domestic power tool units of greater output and higher speeds, the "Quartermaster" was introduced, followed in 1958 by the "Safety-master," the first "double insulated" electric tool of its kind.

Over the course of the past 60 years, sales and service branches have been established at Birmingham, Bristol, Glasgow, Leeds, Manchester, and Newcastle. Overseas a recently enlarged branch in Toronto is effectively meeting Canadian needs and in Australia separate manufacturing and sales companies are flourishing. In India also a joint manufacturing enterprise in Bombay is being developed in collaboration with Indian interests.

The original Pioneer Works have been extended on several occasions and two adjoining factories taken over, with a third one—offering an additional 50,000 sq ft of production space—due for occupation early in 1961. In addition to the main works four factories are in operation on the Slough Trading Estate.

Overhead Line Fittings

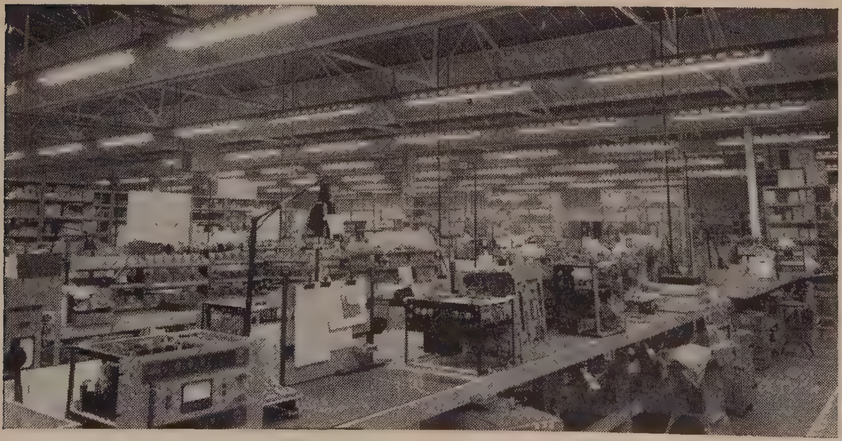
A NEW British Standard, B.S. 3288 : 1960, "Insulator and Conductor Fittings for Overhead Power Lines. Part 1: Performance and General Requirements," has been prepared to give standards of performance for the various kinds of fittings used on overhead power lines in close association with the insulators and conductors. The part now published gives general requirements and specifies tests. It applies to almost all types of fitting and to fittings made of any material. A second part, which is now in course of preparation, will deal with dimensional standardisation and will be confined to a limited range of fittings, based on present practice in the United Kingdom.

The mechanical requirements are related to the failing load of the fitting which is, in effect, the highest reading that can be obtained on the testing machine, regardless of the method of failure. In this way, difficulties resulting from different views on permanent set, yield point and ultimate strength have been avoided. It is left to the user to decide on the relationship between the maximum working load and the specified minimum failing load, with due regard to all the circumstances and any relevant statutory regulations.

It is recognised that some of the tests, particularly the heating-cycle test for tension and non-tension joints and anchor clamps, are not yet established in commercial practice. For this reason it may be necessary to review the specification after a shorter interval than would normally elapse before revision, with a view to making any amendment that may appear desirable in the light of experience.

Copies may be obtained from the British Standards Institution, Sales Branch, 2, Park Street, London, W.1, price 5s.

Lighting in an Electronic Equipment Factory



The new electronic equipment factory of E. K. Cole, Ltd., at Rochford, nr. Southend, has been equipped throughout with "Ekco" lighting fittings designed and produced by their associate company, Ekco-Ensign Electric, Ltd. More than 300 5ft fluorescent fittings on 6,000ft of industrial trunking have been installed, providing shadow-free lighting

TYPE 4 LOCOMOTIVES IN SERVICE

The first two of an order for 137 Type "4" locomotives using Sulzer/Crompton Parkinson equipment have recently been completed at the Derby and Crewe locomotive works of British Railways. The locomotives are generally similar to the first series, already in service on the London Midland Region, but are fitted with the newer version of the Sulzer 12-cylinder double-bank engine. This incorporates a simplified inter-cooler for charge-air cooling whereby the continuous output of the engine is raised to 2,500 h.p. at 750 r.p.m. These engines are also being fitted to 66 further Type "4" locomotives, which will be supplied to British Railways by the Brush Electrical Engineering Co., Ltd., with Brush electrical equipment.

Brit.I.R.E. Convention

Next year's convention of the British Institution of Radio Engineers will be held at Oxford University from 3rd to 9th July. The theme will be "Radio Techniques and Space Research."

GLASGOW ELECTRIC TRAIN INQUIRY

Five Transformer Failures

WHEN the public inquiry opened at Glasgow last week into incidents on the city's newly electrified lines, it was told that there was an explosion in the guard's van of an electric train at Charing Cross, Glasgow, during a trial run on 30th October, a week before the new services started. In all, five failures in transformers, causing fires or explosions, occurred before all the trains were withdrawn from service on Sunday, 18th December.

The inquiry, which had been stated originally to be into the explosion on an electric train at Renton on 13th December, in which several people were injured, had been extended in scope to cover the cause of the main incidents which led to the suspension of the services, and the measures which were taken to prevent a recurrence of them. Brigadier C. A. Langley, chief inspecting officer of railways, was conducting it on behalf of the Ministry of Transport. Attending the inquiry was Mr. F. J. Lane, partner in the firm of Preece, Cardew & Rider, consulting engineers, who have been asked by the Ministry of Transport to make "independent technical investigations into the failure of electrical equipment on the Glasgow suburban trains." Mr. D. Johnston, Q.C., M.P., represented Associated Electrical Industries, Ltd., manufacturers of the electrical equipment, for whom Mr. F. Whyman, general manager of their traction division, questioned witnesses on technical subjects.

Not a Court

Brigadier Langley emphasised that the inquiry was in no way a court to determine legal liability of any kind. He spent Wednesday (21st December) at A.E.I.'s Manchester works examining equipment, including the defective transformers. Mr. S. E. Raymond, assistant general manager of the traffic division of the Scottish Region of British Railways, gave details of the five incidents and the attempts to correct the faults. Describing the action taken on the technical side, he said that after the explosion on 30th September, which occurred in the leading guard's van on an empty six-car train, the damaged unit was examined by the manufacturers and technical officers of the British Transport Commission and certain modifications were carried out to prevent further explosions. No electric train was allowed into service until this had been done by the manufacturers. (The service opened on 7th November.)

On 14th November there was a further incident involving the transformer of a train consisting of two three-car sets. No explosion occurred here; the previous modifications appeared to have worked satisfactorily. The transformer on one of the units, however, was found to be defective.

The fact that an explosion occurred in the guard's van of the Renton train was *prima facie* evidence that, although the explosion did not appear to have been as violent as that at Charing Cross, the modifications had on this occasion not worked completely.

An examination of the unit of the Renton train was conducted by representatives of A.E.I. and the B.T.C., with Brigadier Langley in attendance. It was understood that the source of both the Charing Cross and the Renton explosions was in the transformer.

Modifications

The immediate concern was the protection of the passengers and staff. It was decided that further modifications should be carried out, and an assurance was given that they would remove the danger from the guards' vans. It was decided that no electric train would be allowed into public service until these modifications had been carried out. Work proceeded throughout the nights of Wednesday and Thursday, 14th and 15th December, and by 4 a.m. on the Thursday, 44 three-car trains had been modified. The railways' minimum requirement was 50 three-car trains. Therefore the service was short. But the order that only modified trains should be used was strictly enforced.

On 14th December a transformer failed, apparently in the same circumstances, on a train of two three-car units. But the modifications worked, because no explosion took place and no injuries were sustained by passengers or staff.

This was followed by a second incident on Saturday, 17th December, also on a train of two three-car units. Soon after leaving Shettleston station the guard requested a reset of the pantograph on one of the units. The driver was unable to effect this and as the train left Garrowhill station a white vapour was seen issuing from beneath the rear vehicle. Three bangs occurred, and smoke was seen. The train was stopped and the driver played a fire extinguisher on the source of the smoke. The under-parts beneath the transformer seemed to be smouldering, but there was no sign of fire.

Pressure in Transformer

"When we came to examine this set the same fundamental trouble as had occurred in the accident at Renton and the incident at Parkhead the same week was indicated," said Mr. Raymond. "While the modifications carried out on 15th December appeared to have worked, the pressure in the transformer itself was so extreme that the bottom casing lid was sheared off on three sides, and it was hanging with some of the contents of the transformer in a position very close to rail level. Although the modifications gave protection to the guard and passenger accommodation, a new risk had appeared for the first time. This involved danger to the undercarriage equipment and to the track, and in the early hours of Sunday morning (18th December) the management decided to withdraw the trains from public service immediately. This was done in the interest of the passengers and our staff until the fundamental cause of the troubles could be established and a permanent cure found."

Mr. Raymond explained that there were another two failures in transformers, but these were of a quite different cause and were remedied.

Mr. D. E. Doddridge, rolling stock assistant to the chief mechanical and electrical engineering officer, said he examined the unit from the Renton train and found that the bottom cover of the transformer was detached along three sides and was hanging down close to rail level. Certain parts inside the transformer were bent. There was no oil in it. The conservator tank was badly damaged and empty. There was a slight indication around the vent of it that oil had come through the conservator. This suggested to him that there had been some pressure generated inside the transformer, causing oil to flow up from the breather pipe, through the conservator tank, and to flood out through the vent.

Second Thoughts

On the second day of the inquiry Mr. J. A. Broughall, electrical engineer (development) of the British Transport Commission, described incidents in which "vaporised oil" in the transformer had ascended by the connecting pipe to the conservator tank and later became mixed with air, causing an explosion or fire with damage to the equipment.

After the explosion in the train at Renton, they had thought again about the equipment. Modifications made after a previous incident had not worked out as expected. There had been no history of transformer failures in other electric trains of this type in Britain. There had been certain similarities between the stock here and the stock on the Shenfield line (from Liverpool Street, London) but there were also differences which could be vital.

They had considered removing the conservator tank and putting it at the end of the vehicle, and had decided before the final fire on the Scottish trains last Saturday to do this. They did not think it was essential to do this quickly, but believed that this was a "desirable" time to do it.

Recalling the technical examinations of five electric trains on which there had been explosions or slight fires in the transformers and conservator tanks, he said that on the first one, a train on a trial run at Charing Cross, Glasgow, on 30th October, it was agreed afterwards by the manufacturers (A.E.I.) and the British Transport Commission that in the compartment where the conservator tank was situated, a mixture of hot oil vapour and air had caused an explosion, ignited by a small spark from one of the auxiliary protectors on the cover. Practical provision had not been made for the presence of oil vapour.

Brigadier Langley asked Mr. Broughall how the gases had got into this compartment since the conservator tank was not open to the air. Mr. Broughall replied that they must assume that gas under pressure had entered the tank and lifted the cover, because the conservator tank was not a pressure vessel.

Although the primary winding in the transformer had been in good condition, the secondary winding had become overheated, and this had been the substantive cause of the mishap. This overheating had caused heavy gas pressure, which had vented itself at the joints and had bulged the tank.

To ensure that no one would be injured in a second occurrence of the same kind, A.E.I. had provided a new, 1in, bend pipe which could be fitted quickly into a plug at the top of the conservator tank.

The fault in a train at Dalmuir Park, on 14th November, led them to believe that their protective measures had been effective. The gases had been vented through the new pipe. There had been no explosion and no danger.

Fundamental Cause Unknown

However, they had still been looking for the fundamental cause. In association with A.E.I. they had selected four transformers, including the oldest one in service, to be taken out of service and sent to Manchester for examination. He was handing in minutes dealing with these examinations.

Mr. Broughall also pointed out that the difficulty in finding the cause of these transformer failures had been magnified because of the severity of the damage. During trials before the opening of the service the trains had run a total of 100,000 miles and one train had run more than 20,000 miles.

Public Reassured

The Renton explosion was smaller than the one at Charing Cross. Gas had escaped and they had had no alternative but to think that there was a possibility of a leak which they had not foreseen.

A suggestion was accepted from A.E.I. that gas should be reduced by a constriction in the pipe from the conservator tank to the transformer. A hole had been made in the roof and another in the floor below the compartment to dispel gases. Modifications had been made, and an assurance given that the guards were guaranteed their safety.

On 14th December a transformer had failed on another train at Carntyne, Glasgow. This train had been fitted with the first modifications but not the second. There was no explosion or damage.

On 17th December there was another failure, this time on a train fitted with the second modifications. Brigadier Langley said that he was in Glasgow at the time. The pressure in the transformer of this train had been higher than had been expected; it was becoming dangerous. The transformer had been sent to Manchester for examination by A.E.I.

Mr. Broughall said they thought now that they should further ventilate the compartment containing the transformer and conservator tanks on the trains. This would prevent the mixture of hot oil vapour and air. The public could be assured that it was perfectly safe.

Mr. F. Whyman, general manager of the traction division of A.E.I., said that his only disagreement with Mr. Broughall related to the transformer oil. He felt that it had not been a vaporising of oil, but "cracking" of oil into combustible gases, due to very great heat. He was not happy about a breathing system in which the air came into direct contact with the oil. Another system was considered when the transformers were designed but there was not the room to fit it.

When the inquiry concluded Brigadier Langley said that the cause of the transformer failures had not been found. A more detailed technical investigation would be made at the highest possible speed and Mr. F. J. Lane (Preece, Cardew & Rider) had been appointed to make this independently. It was possible that the present inquiry would be reconvened in public after Mr. Lane had submitted his report. In any case Brigadier Langley's report on the present proceedings will be submitted to the Minister of Transport and published as soon as possible.

Technical Developments in Sydney

IN his latest annual report Mr. C. E. Ranger, general manager of the Sydney (N.S.W.) County Council electricity undertaking, refers to the growing use of digital computers for the solution of technical problems. These were used for the analysis of the cost of supplying electricity to various customer groups and a programme was developed to enable this work to be placed on a routine basis. Computers were also used for determining the demand and energy losses resulting from the use of the Council's system to supply contiguous distribution undertakings. Work is proceeding on the development of a programme to determine the ratings for 33 kV cables on the Council's system. With the use of computers, the determination of these ratings, which are prepared biennially, should be completed in two to three weeks instead of the several months previously required when computations were made manually.

Several electronic devices using transistors were designed and manufactured. Among these were a live line detector for the testing and phasing of high voltage overhead lines, an underground cable identification set consisting of a lightweight transmitter and receiver, and a 15 W battery operated fluorescent light for use by cable jointers. An investigation of the impulse strength of a pole-mounted transformer assembly with varying arrangements of the components was carried out at the high voltage laboratory of New South Wales University.

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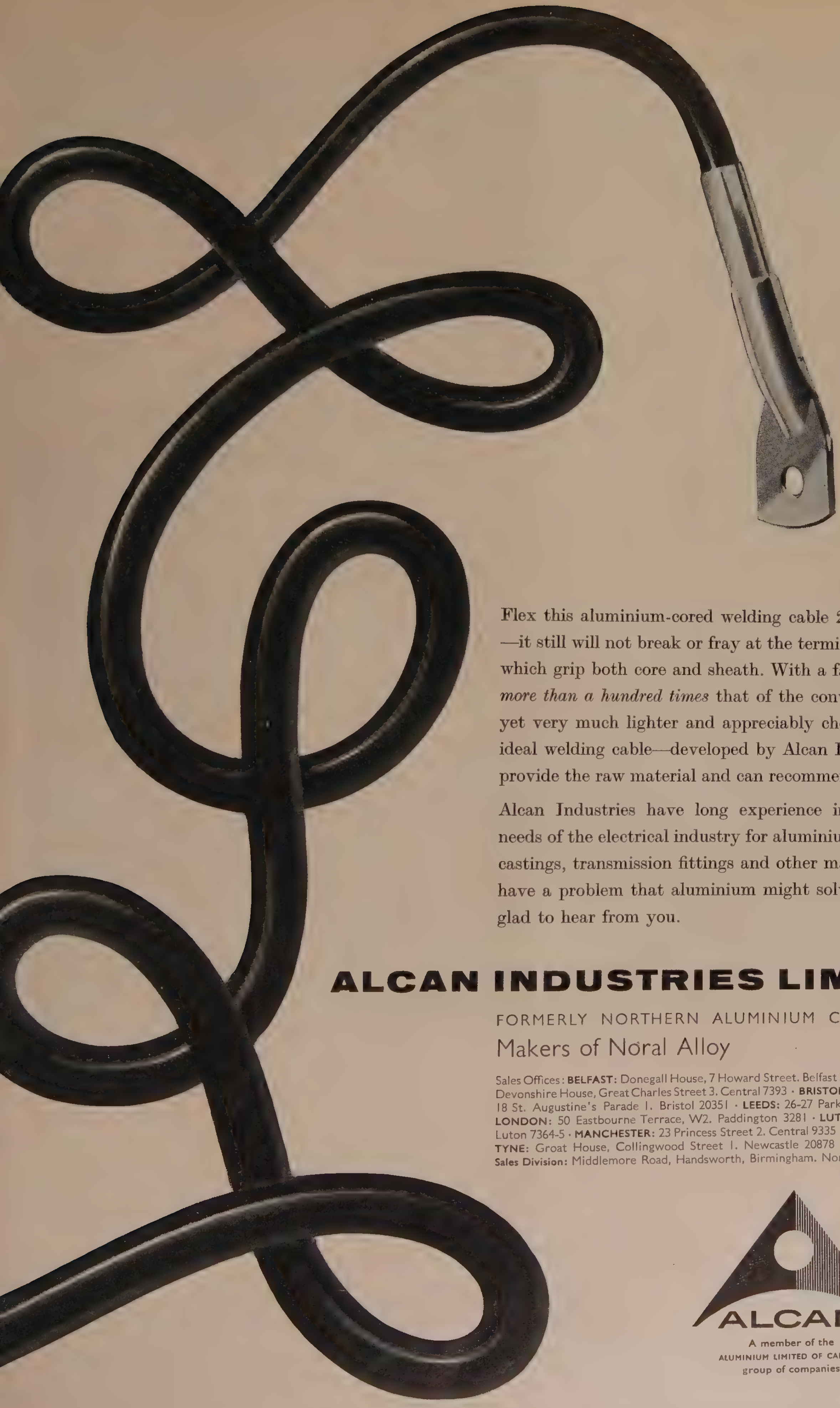

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E.T.U. ACTION : "GRAVE CONTEMPT"

IN the Queen's Bench Divisional Court on 21st December an application by Mr. J. T. Byrne and Mr. F. Chapple, officials of the Electrical Trades Union, for a writ of attachment for contempt of court against Mr. F. Haxell, general secretary, and Mr. G. Scott, national officer, and against the Union, was adjourned on an undertaking given by Mr. Haxell and the Union. This was that the Union would send out a circular to branch secretaries making it clear that there was nothing to prevent any branch secretary or any official from giving information to the applicants or their solicitors on matters relevant to an action being brought by the applicants against certain officials of the Union which was to be heard in the High Court next term. The Court also ordered that Mr. Haxell should pay the costs of the application both against himself and the Union and that Mr. Scott should pay the applicants' costs against him.

Contempt was alleged in a speech made by Mr. Scott to a meeting of shop stewards in London on 28th October and in a circular sent to branch secretaries by Mr. Haxell on 30th November.

Mr. Haxell submitted in an affidavit that the circular had been misconstrued by the plaintiffs. The intention was not to prevent the plaintiffs' solicitors from approaching potential witnesses, but to point out to members that any person who approached them for information should be properly authorised. If the Court took the view that any contempt had been committed, he added, he deeply regretted it and apologised personally and on behalf of the Union.

Mr. Scott, in an affidavit, denied expressing opinions attributed to him. He certainly had no intention of committing contempt. If, however, anything constituted contempt, he apologised.

Giving judgment, the Lord Chief Justice, Lord Parker, said he was quite unable to accept Mr. Haxell's statement that he did not intend in any way to interfere with the course of justice by preventing any member from disclosing information to the plaintiffs or their solicitors. Accordingly, his Lordship viewed this matter as a very grave contempt and one which, in the ordinary way, would fully merit a period of imprisonment; but he did not want to do or say anything which would prevent the civil action from being properly prepared on both sides.

So far as Mr. Scott was concerned, there was a conflict of evidence as to what he did say at the shop stewards' meeting. His Lordship thought that what he admittedly said was clearly a contempt of court, the whole question being *sub judice* and due to come on early next term. His Lordship found it unnecessary to suggest that Mr. Scott should give any undertaking. He thought it would be enough if the Court made it perfectly plain that any speeches of this sort between now and the completion of the hearing of the action which made any suggestion of this sort would be looked upon as a grave contempt of court.

Mr. Justice Streatfeild and Mr. Justice Ashworth agreed.

Wholesalers' New Premises

Rich & Pattison (B'ham), Ltd., electrical wholesalers and manufacturing engineers, have moved to Essex House, Kent Street, Birmingham, 5 (telephone: Midland 8341). The new premises, which are situated a quarter of a mile from the old address, have been specially built and consist of a two-storey building which includes a car park. An area of approximately 15,000 sq ft has been devoted to modern stores, spacious showrooms containing all types of domestic and industrial lighting fittings and equipment, and a trade counter. Special facilities are available for receiving and delivering goods at the goods entrance in Kent Street. The new premises are to be officially opened on 17th February by the Lord Mayor of Birmingham.

New English Electric Showroom

General view of the showroom now opened by English Electric's Domestic Appliance Division at the company's new headquarters in London

THE sales and marketing headquarters' staff of the English Electric Co.'s Domestic Appliance Division has now moved to the company's headquarters at English Electric House, London, W.C.2, where an attractive new showroom has been opened. In the showroom there will be a permanent display of all the latest English Electric cookers, refrigerators and home laundry equipment and a member of the home economist team will be in charge to advise customers.

Each appliance is mounted on a simple mobile stand, so that the layout of the showroom can easily be changed. A panoramic view of the Cotswold countryside, stretching from floor to ceiling along one wall, forms the main decoration. An illusion of distance has been created by spacing along this wall a colonnade of black pillars each carrying two coloured tiles through which the country view is seen. Brilliant colours to contrast with the white and cream finish of the appliances have been used in the décor with shades of green and grey for the ceiling panels and red for the carpet.

Demonstration facilities are provided in a separate kitchen in the new building. This will be used by the home economists for their advisory service to customers.

C.E.G.B. Contracts Include Two 350 MW Sets

CONTRACTS for power stations, transmission lines and transforming stations, amounting in value to £13·4 million, have been placed by the Central Electricity Generating Board during the past month. The principal contracts are as follows:—

Blyth "B" power station:—Two 350 MW turbo-generators, feed water heating plants, boiler feed pumps and auxiliaries—English Electric Co.; 415 V switchgear, contactors and accessories—M. & C. Switchgear.

Thorpe Marsh (near Doncaster):—High-pressure pipework and valves for No. 1 generator and No. 1 boiler—Aiton & Co.

Rugeley:—Auxiliary control and instrument cables and accessories—N. G. Bailey & Co.

Oldbury:—Site access road improvements—Gloucestershire County Council.

Hams Hall "A":—15 MW Olympus powered gas turbine generating plant—Bristol Siddeley Engines.

Drakelow "C":—Main foundations—J. L. Kier & Co.; circulating water pumps—Drysdale & Co.; c.w. valves for sets 9 and 10—Guest & Chrimes; c.w. valves—J. Blakeborough & Sons; coal handling plant—International Combustion Products; high-pressure pipework and valves for units 9 and 10—Babcock & Wilcox.

Staythorpe "B":—No. 2 cooling tower—Davenport Engineering Co.

West Thurrock:—Generator transformers Nos. 3 and 4—Associated Electrical Industries; reinforced concrete coal reclaim bunkers—Bierrum & Partners; mobile coal handling plant for units 1 and 2—John Blackwood Hodge & Co.

Richborough:—Surfacing of coal store area—J. L. Kier & Co.

Bankside:—Flue gas-washing plant—Head Wrightson Processes.

Paddington substation:—Two 66/22 kV, 45 MVA transformers—Ferranti.

Brimsdown substation:—33 kV switchgear modifications—Associated Electrical Industries.

Carrington substation:—132 kV air-blast switchgear—A.E.I.

Lancaster substation:—Two 132/33 kV, 45 MVA transformers and auxiliaries—C. A. Parsons & Co.

Corby substation:—275 kV switchgear—A.E.I.; 132 kV switchgear—General Electric Co.

Taunton substation:—132 kV switchgear—A.E.I.

Skelton Grange "B":—132 kV switchgear—A.E.I.

Whitson substation:—33 kV switchgear—A. Reyrolle & Co.

Hawker-Penwortham:—Second circuit 275 kV overhead line—Watshams.

Sundon substation:—132 kV cables—Pirelli-General Cable Works.

New Cable Testing Organisation

A group of cable manufacturers have joined together to form the British Electric Cable Testing Organisation. The company was registered on 14th December as a company limited by guarantee without share capital. The original number of members is 50, each being liable for £10 in the event of winding-up. The organisation is non-profit-making and its income and property will be applied solely towards the promotion of its objects. The management is vested in a Council, the first members of which are not named. The subscribers are: Associated Electrical Industries, Ltd., Aberdare Cables, Ltd., Aerialite, Ltd., British Insulated Callender's Cables, Ltd., Enfield-Standard Power Cables, Ltd., William Geipel, Ltd., General Cable Manufacturing Co., Ltd., Johnson & Phillips, Ltd., Permanoid, Ltd., Pirelli-General Cable Works, Ltd., Reliance Electric Co., Ltd., and Ripaults, Ltd.

TRADE ANNOUNCEMENTS

The **Bowthorpe Electric Co., Ltd.,** in association with **Line Equipment, Ltd.,** have established a new distribution branch at 32, Woodville Street, Glasgow. Mr. W. Allan has been appointed branch manager. Bowthorpe House (telephone: Govan 3681/2) will stock a comprehensive range of the companies' products, and orders from the Scottish region should be sent to this address.

Opperman Gears (Holdings), Ltd., announce the purchase of W. J. Mariner & Co., Ltd., Luton. Mr. E. R. Opperman is now the chairman of W. J. Mariner & Co. Mr. J. A. Mariner, the son of the founder, continues as managing director. Mr. W. B. McCurd and Mr. P. S. Lane are also on the board.

Power Supply Position

Replying to a question in the House of Commons, the Minister of Power (Mr. Wood) said that if the exceptionally heavy increase in demand for electricity continued and if exceptionally severe weather coincided with the winter peak demand it might on occasions be difficult to maintain normal voltage and frequency for an hour or so in the morning and evening. But it was most unlikely there would be load shedding on a substantial scale.

Kent Railway Electrification Accelerated

THE first electric trains are to come into service on the Kent coast between Dover and Ramsgate next month—eighteen months ahead of schedule. This is part of the line being electrified under Phase 2 of the Kent Electrification Scheme—the route from Sevenoaks to Ramsgate via Ashford and Dover and its branches between Paddock Wood and Maidstone West, Maidstone East and Ashford, Ashford and Minster and Folkestone Harbour. Electric trains have been running on the other main line to Dover (via Chatham) for nearly eighteen months, and have brought a spectacular increase in passengers. The target date for similar services in this second phase is June, 1962. But as the section Dover-Minster-Ramsgate has already been completed the line traffic manager has decided to start replacing the steam trains on 2nd January. They will run to existing schedules.

A Southern Region spokesman said, "We can't yet speed up the train service in the way that we will do when electrification is complete; for the time being steam and diesel trains will still be running on the same stretch of line as well as the electric trains. But we think that passengers should start getting some of the advantages of modernisation as rapidly as possible."

It is likely that as further stretches of line are electrified more electric trains will take over from the existing steam and diesel services. Electrifying the 45 miles of track between Dover, Minster and Ramsgate took about 14 months. Work started in August, 1959, and the first test trains began running at the end of October this year. The engineers were able to complete their work in this time because they did not face major engineering problems on the same scale as in the first phase.

Forty-five miles of conductor rail have been installed and 21 miles of troughing provided for high voltage and pilot cables. Five substations and six paralleling huts have been constructed. Engineering work at four stations is being undertaken to enable eight-car trains to be dealt with.

U.K. Electrical Trade in November

ELECTRICAL exports from the United Kingdom in November were valued at £23·9 million, re-exports at £442,510 and imports at £5·6 million. These high figures, the Board of Trade points out, reflect the clearing of goods delayed by the strike of tally clerks at the London docks in September and October.

As a result of the higher exports last month, the total figure for the eleven months of 1960 was, at £212·2 million, once again slightly above that for the corresponding period of 1959. The actual increase was £432,817. Exports of manufactures other than vehicles regained the level of the first five months of the year in the period September to November. Exports of electrical machinery and appliances, though less than a year earlier, may have stopped falling. In the period January to May, 1960, electrical exports were 3 per cent higher than a year earlier, in June-August 2 per cent lower, and in September-November 3 per cent lower.

Exports of all the main classes of electrical goods except

TABLE I.—ELECTRICAL EXPORTS

Class	Month of Nov. 1960	Eleven months ended 30th November 1959	Eleven months ended 30th November 1960
	£	£	£
Generating sets:			
Diesel driven not exceeding 10 kW	140,814	1,221,017	1,390,334
10 kW to 65 kW	134,693	1,480,507	1,468,715
65 kW to 200 kW	164,443	1,684,947	1,244,484
Over 200 kW	154,825	2,917,920	1,731,862
Driven by steam turbines	91,459	676,646	780,644
Driven by spark ignition engines, hydraulic turbines or other prime movers	189,404	483,883	479,315
Generators:			
Not exceeding 200 kW	95,337	1,110,468	946,832
Over 200 kW	38,815	856,955	946,830
Parts	595,728	7,684,572	6,778,569
Motors, complete, other than railway, tramway and trolley-bus:			
Not exceeding ⅛ h.p.	305,620	1,931,435	2,518,092
Over ⅛ h.p. but under 1 h.p.	100,155	553,848	784,636
1 to 250 h.p.	592,113	4,686.182	5,136,729
Exceeding 250 h.p.	175,109	2,209,214	1,825,752
Railway, tramway and trolley-bus motors, complete, and parts of all motors	340,969	2,834,858	2,204,450
Starting and controlling gear for electric motors	291.760	3,477,482	2,926,065
	3,412,244	33,809,934	31,163,309
Converting machinery	49,342	532.342	737,604
Mercury-arc rectifiers	22,308	737,841	457,658
Transformers for lighting, heating and power (including coils):			
Not exceeding 7,500 kVA	410,607	5,084,798	4,834,956
Over 7,500 kVA	453,375	5,480,746	3,193,846
Switchgear and switchboards (excl. telegraph and telephone):			
Switchgear up to 200 A and not exceeding 660V	388,647	3,883,523	4,694,471
Other	1,242,209	12,725,631	11,705,227
	2,566,488	28,444,881	25,623,762
Batteries and/or cells, primary:			
For all lighting purposes	130,242	1,082.739	1,206,371
For radio	528,849	3,835.945	4,451,671
Other	67,112	391,387	462.968
Parts (excl. carbons)	100,562	530,202	616,786
Lamps:			
Filament, exceeding 28 V	140,600	991,534	1,080,490
Not exceeding 28 V	59,165	313,566	333,118
Arc lamps, complete*	12,311	170,870	100,570
Discharge lamps, luminous tubes, fluorescent tubes, etc.	117,648	985,818	997,609
Radio and television, etc., apparatus:			
Thyratrons, hot cathode mercury vapour and gas-filled rectifiers (excl. mercury-arc rectifiers), photo-electric cells (excl. photo-transistors), stabilising and cold cathode valves, magnetrons, klystrons	71,194	464.703	607,182
Cathode ray tubes	37,969	748,776	554,716
All other*	543.017	4,590,024	4,603,451
Parts (excl. glass bulbs)	73,778	336,391	579,194
Broadcasting and television transmitters	244,550	984,355	848,078
Communication and navigational and radar equipment	1,730,542	17,785,805	15,806,436
Domestic receiving sets, mains	93,103	921,660	774,403
Battery (incl. complete vibrator sets)	169,512	647,223	944,491
Other (incl. mains/battery and car)	38,567	330,770	303,806
Radiograms	46,111	280,338	321,861
Television receiving sets	148,969	719,547	889,508
Public address equipment	171,534	1,022,360	1,132,120
Other radio and television apparatus, n.e.s.	203,104	825,824	1,398,534
Components and parts, n.e.s.	1,387,823	9,209,091	12,516,251
	4,959,773	38,866,867	41,280,031
Telegraph and telephone installations	707,145	7,799,846	6,465,499
Telephone instruments	216,038	1,118,060	1,823,419
Parts	772,172	8,379,386	7,095,694
Line apparatus for long distance communication	283,065	2,669,991	2,410,595
	1,978,420	19,967,283	17,795,207
Cookers	47,014	436,238	467,219
Toasters	24,461	207,219	184,912
All other cooking appliances	51,138	435,621	441,151
Parts and accessories	107,417	971,287	935,814
Space heating appliances	63,204	294,954	322,488
Water heating appliances	28,080	317,966	302,759
Other heating appliances	54,688	311,072	360,537
Parts and accessories	110,738	918,920	974,732
Irons	115,522	816,982	815,540
Arc welding equipment, a.c.	48,696	408,399	494,514
D.c.	43,175	522,748	539,419
Resistance welding	47,158	356,894	398,901
Electric furnace plant	94,100	947,073	1,035,545
Magnetos, ignition	6,312	132,364	98,573
Sparking plugs	223,238	1,825 163	2,240,354
Electrical appliances for aircraft	283,008	3,589,176	3,088,693
For motor vehicles	641,693	4,569,341	6,255,493
For cycles	50,907	447,677	548,309
Signalling apparatus (incl. traffic signals)	124,440	2,210,380	1,302,673
Instruments, commercial	219,474	1,894,100	2,053,789
House service meters (electrical) incl. parts	184,280	1,534,632	1,640,261
Electro-medical apparatus (excl. deaf-aids and X-ray apparatus and batteries)	54,382	361,110	487,107
X-ray apparatus (excl. tubes and valves)	76,688	556,756	574,766
Ceiling fans	98,139	872,621	899,979
Desk fans, and parts of desk and ceilings fans	60,804	282,664	324,234
Vacuum cleaners	283,821	1,528,780	1,957,431
Floor polishers	91,079	775,808	734,117
Food mixers	168,889	778,246	727,026
Hair clippers and dry shavers	239,301	625,585	1,215,121
Other portable appliances	84,775	259,165	414,578
Parts	339,516	1,505,520	2,105,675
Portable elec. tools, incl. parts*	424,585	2,324,970	2,838,491
Telegraph and telephone cables and wires:			
Submarine	32,330	4,096,467	1,578,264
Other	222,899	4,084,598	3,513,458
Other descriptions:			
Cotton, silk or man-made fibres insulated	42,063	221,095	284,232
Enamel, glass or asbestos insulated	168,575	1,021,823	1,338,763
Paper insulated	577,472	5,828,366	5,846,268
Rubber insulated	284,821	3,165,056	2,818,660
Thermoplastic insulated	303,630	2,855,875	3,270,335
Other	265,610	1,802,608	2,130,510
	1,897,400	23,075,888	20,780,490
Accumulators for motor vehicles	126,036	1,544,937	1,420,089
For traction purposes	5,410	205,653	215,708
For radio, and other portable	47,885	355,225	384,293
All other accumulators	38,795	551,343	356,059
Parts and accessories	100,308	922,711	949,809
Electric wiring accessories	246,657	2,240,100	2,264,219
Electrical ware (incl. insulators) of ceramic materials, n.e.s.	112,630	1,108.262	1,258,000
Industrial electronic control equipment	236,613	1,480,958	1,890,097
Insulators and insulating materials, n.e.s.;			
Cloth and tape	80,377	625,073	751 723
All other	169,539	1,518,462	1,421,249
Permanent magnets	79,574	511,942	718,592
Radio, telegraph and telephone testing equipment, n.e.s.	173,731	1,370,067	1,502,961
Scientific electrical instruments (excl. telegraphic and telephonic; time recorders and time switches)	693,879	3,833,400	4,972,942
All electric machinery, apparatus and appliances, n.e.s.			
Machinery	37,642	453,168	410,310
Other	1,266,514	9,565.855	11,017,684
	23,907,126	211,773,501	212,206,318

* Figures for 1960 are not completely comparable with those for 1959.

radio and electronic equipment remained below last year's levels, but there were some increases in individual items against the general trend. Thus exports of motors up to 250 h.p., small switchgear and thermoplastic cables were all up on last year. The slight increase in the radio and electronic equipment group was due to an increase in exports of miscellaneous electronic components. There were also increases in exports of electrically operated mechanical appliances such as vacuum cleaners, food mixers and dry shavers, of washing machines and of portable power tools, but the total value added to exports was comparatively small. Exports of both electric and diesel electric locomotives were lower than last year but exports of steam turbines were up by over £2 million.

Electrical Imports

The eleven months' total of imports of electrical equipment and apparatus, at £43·3 million, was £13·2 million (36 per cent) higher than a year earlier. In the period September to November imports increased slightly compared with a year earlier, the change being almost entirely in capital goods.

TABLE 2.—DISTRIBUTION OF EXPORTS (TABLE I)

Country	Month of November 1960	Eleven months ended 30th November 1959	Eleven months ended 30th November 1960
	£	£	£
Gibraltar	37,319	112,253	251,272
Malta and Gozo	50,618	509,758	480,919
Cyprus	95,427	641,358	685,701
Sierra Leone	44,689	389,463	403,748
Ghana	489,248	2,583,247	2,891,949
Nigeria	507,996	5,065,079	5,267,818
Union of South Africa	1,291,285	17,073,330	14,065,862
Rhodesia and Nyasaland	681,994	6,965,904	6,657,242
Tanganyika	49,638	490,152	509,459
Kenya	175,615	1,844,009	1,963,993
Uganda	35,559	463,817	372,317
Mauritius	62,397	566,546	771,932
Aden	98,117	538,841	656,041
Bahrain, Qatar and Trucial States ...	135,861	1,230,997	1,286,431
Kuwait	154,703	2,141,021	1,978,690
India	1,121,666	19,147,783	13,585,836
Pakistan	439,649	2,522,826	3,682,966
Singapore	287,936	2,636,186	2,387,284
Federation of Malaya	271,115	2,409,540	2,318,833
Ceylon	225,733	2,076,127	1,901,144
British North Borneo	43,741	516,758	233,525
Sarawak	24,036	144,579	178,654
Hong Kong	627,548	4,408,745	4,560,898
Australia	2,615,321	18,013,422	19,717,278
New Zealand	1,285,164	8,591,258	9,226,018
Fiji	40,371	289,950	216,072
Canada	1,577,654	12,455,718	11,977,227
Jamaica	238,181	1,589,405	1,850,359
Barbados...	112,847	338,812	449,866
Trinidad	169,912	1,379,535	1,522,569
British Guiana	60,699	650,006	713,308
Other Commonwealth countries ...	219,868	2,253,266	1,903,266
Irish Republic	518,380	3,532,458	4,692,843
Soviet Union	192,485	1,126,386	1,386,439
Finland	286,403	1,173,432	1,993,782
Sweden	667,915	5,036,198	5,539,444
Norway	429,691	2,278,043	3,142,617
Denmark	283,641	2,607,330	2,880,615
Poland	55,104	734,831	887,863
Western Germany	715,024	5,611,323	5,946,813
Netherlands	688,556	6,881,879	6,804,236
Belgium	300,067	3,202,714	3,155,966
France	344,953	2,810,950	3,569,710
Switzerland	219,241	1,865.553	1,659,475
Portugal	144,409	2,093,467	2,052,989
Spain	147,655	1,733,310	1,962,476
Italy	552.230	3,335,626	4,611,212
Austria	52,386	487,269	736,158
Yugoslavia	201,608	755.105	1,138,815
Greece	109,619	1,232,014	1,021,144
Turkey	89,114	638,300	1,094,441
Belgian Congo	3,494	577,408	391,950
Portuguese East Africa...	69,644	302,758	503,327
Egypt	126,504	1,558,127	1,033,359
Libya	49,557	714,315	641,203
Morocco (excluding Tangier)	36,018	302,380	299.882
Sudan	169.100	948.870	1,390,972
Syria	10,669	245,350	377,390
Lebanon	82,025	577,823	594,239
Israel	95,038	1,099,621	961,325
Jordan	110,732	813,835	773,879
Saudi Arabia	69,089	575,909	584,517
Iraq	295,551	2,902,114	2,523,819
Iran	176,402	3,253,022	2,271,879
Burma	45,648	1,114,281	558,781
Thailand	81,124	848,663	702,749
Indonesia	262,453	493,120	1,133,044
China	202,129	594,599	1,288,533
Japan	78,243	726,464	698,470
United States of America	1,167,079	13,562,168	11,542,202
Cuba	72,980	373,343	356,296
Mexico	149,382	577,673	1,187,152
Colombia	23,966	356,375	438,555
Venezuela	303,272	3,968,893	3,056,577
Peru	44,086	352,901	307,330
Chile	57,119	974,036	804,514
Brazil	57,967	849,511	493,897
Uruguay	17,723	93,451	235,125
Argentine Republic	363,938	2,103,955	4,238,279
Other foreign countries	415.806	3,736,658	3,871,558
TOTAL	23,907,126	211,773,501	212,206,318

TABLE 3.—SOURCES OF ELECTRICAL IMPORTS

Country	Month of November 1960	Eleven months ended 30th November 1959	Eleven months ended 30th November 1960
	£	£	£
Australia	34,746	495,308	408,782
Canada	135,212	983,192	1,295.666
Other Commonwealth countries ...	303,637	1,747.617	2,543,646
Irish Republic	165,742	1,059,300	1,311,960
Sweden	188,814	1,049,575	1,331,392
Denmark	110,482	615,429	809,072
Western Germany	926,113	6,967,778	8,466,879
Netherlands	766,023	5,744,588	6,580,725
Belgium	79,662	463,235	505.235
France	210.916	1,689,037	2,105,736
Switzerland	256,749	1,557,711	1,912,801
Italy	85,881	1,003,679	1,482,274
United States of America	2,026,008	10,293,443	18,099,920
Other foreign countries	274,398	2,437,352	2,481,406
TOTAL	5,564,383	36,107,244	49,335,494

TABLE 4.—OTHER ELECTRICAL AND ALLIED EXPORTS

Class	Month of November 1960	Eleven months ended 30th November 1959	Eleven months ended 30th November 1960
	£	£	£
Domestic electric washing machines incorporating centrifugal water extraction	535,018	3,993,113	3,386,545
Other, with or without wringers ...	373,541		2,792,401
Dryers (exported as separate units)...	20,383	—	376,495
Parts	144,905	888,900	1,350,399
Electric locomotives (incl. battery types)	414,737	4,998,189	3,587,289
Diesel locomotives with electric transmission	173,335	2,970,962	2,298,502
Welding electrodes:			
Ferrous	151,570	1,033,474	1,309,153
Non-ferrous	41,992	239,214	292,796
Electric conduit tubes and cased tubes	79,042	679,224	941,450
Electric carbons	194,419	1,176,459	1,496,837
Electric lighting fittings and lanterns (excl. arc lamps, searchlights and cycle lamps)	392,244	3,264,928	3,656,884
Electric fork-lift trucks	195,844	846,698	1,190,731
Water and gas turbines, etc.	601,110	3,828,762	4,766,512
Steam turbines	1,350,358	9,812,481	11,899,398

TABLE 5.—ELECTRICAL IMPORTS

Class	Month of November 1960	Eleven months ended 30th November 1959	Eleven months ended 30th November 1960
	£	£	£
Generators, incl. parts	86,400	854,827	1,003,517
Motors, incl. parts	279,980	1,428,623	2,206,682
Convertors; transformers; rectifiers*	183,755	1,125,302	1,823,396
Switchgear and switchboards (not telegraph and telephone)	237,720	1,000,480	1,729,365
Cathode ray tubes, complete ...	66,893	1,590,247	561,410
Other valves, complete*	399,984	2,700,176	3,985,566
Parts (excl. glass bulbs)*	146,948	890,826	1,023,588
Radio receiving sets, domestic or portable	75,522	365,930	538,080
Radio communication and navigational aids, complete	479,717	4,311,224	5,004,435
Other radio and TV apparatus, parts and accessories	508,691	3,603,593	4,516,847
Apparatus for telegraphy and telephony	81,583	879,209	627,894
Welding machinery	91,224	598,153	702,928
Cooking and heating apparatus ...	301,626	1,539,506	2,016,927
Magnetos, ignition and electric appliances for aeroplanes, motor vehicles and cycles	382,521	2,097,940	3,420,807
Electro-medical apparatus (incl. X-ray apparatus)	120,540	928,257	1,076,868
Portable mechanical appliances, electrically operated, complete ...	197,524	1,290,163	1,494,484
Parts	61,000	612,967	626,311
Scientific electrical instruments (excl. telegraphic and telephonic)... ...	418,002	1,641,749	2,791,871
Other machinery, apparatus and appliances	1,444,753	8,648,072	14,174,518
TOTAL	5,564,383	36,107,244	49,335,494

* The figures for 1960 are not completely comparable with those for 1959.

PERSONAL AND SOCIAL

News of Men and Women of the Industry

The Minister of Power has appointed **Mr. G. S. Buckingham**, B.Sc.(Eng.), M.I.E.E., to be a member of the Midlands Electricity Board while continuing to serve as a full-time officer of the Board. **Councillor H. T. Fullwood** retires from part-time membership of the Board on 31st December. Mr. Buckingham is chief engineer of the Board. He was educated at Norwich School and Faraday House where he was awarded a diploma and gold medal. After service with the Yorkshire Electric Power Co. and Pirelli-General Cable Works, Ltd., he held the position of chief purchasing officer of the M.E.B. from 1948 to 1957.

Mr. G. S. Buckingham

Mr. A. N. Irens, M.Sc., M.I.E.E., has been reappointed chairman of the South Western Electricity Board.

Mr. W. F. Brooks, F.C.A., is relinquishing his position as secretary of the British Electric Traction Co., Ltd., to take up an executive appointment with Rediffusion, Ltd. He will be appointed to the boards of a number of companies in the Rediffusion Group. **Mr. Neville Smith,** LL.B., F.C.I.S., secretary of Rediffusion, Ltd., is to succeed Mr. Brooks as secretary of B.E.T., and **Mr. D. A. Smith,** LL.B., chief assistant in the B.E.T. secretariat, will succeed Mr. Smith as secretary of Rediffusion. These appointments date from 1st February.

Sir Archibald Gill, formerly engineer-in-chief of the Post Office, has been appointed chairman of the new B.S.I. Industry Standards Committee on Data Processing.

The members of a delegation which the Federation of British Industries is sending to Nigeria next month to take part in a Nigerian Industrial Development Conference include **Mr. W. Fraser,** chairman and managing director of Scottish Cables, Ltd., and **Sir Bertram Waring,** chairman and managing director of Joseph Lucas (Industries), Ltd.

Presentations were made on 23rd December to **Mr. C. F. Hutley** and **Mr. S. H. Snell** to mark their completion of 50 years' service as sales representatives of Edmundsons Electrical Wholesalers, Ltd., and its predecessors. Both joined the original Sloan Electrical Co. at Golden Lane in 1910. Mr. Snell is retiring this week.

Sir John Wrightson, Bt., chairman and managing director of Head Wrightson & Co., Ltd., has joined the board of A. Reyrolle & Co., Ltd.

Mr. W. Latta has been appointed director and general manager of Rhodes, Brydon & Youatt, Ltd., following the acquisition of that company by Crane, Ltd.

Mr. J. K. Brown, B.Sc., has been appointed principal scientific officer in the electric traction research section, Electrical Engineering Department, of the British Transport Commission. Mr. Brown, who is 48, was born in Edinburgh and obtained his degree at Glasgow University. He joined the Metropolitan-Vickers Electrical Co., Ltd. (now Associated Electrical Industries, Ltd.) as a college apprentice and since 1935, except for the war years when he was engaged on radar work, he has been employed in the Traction Control Department. During the last twelve years he has been in charge of the development section, being responsible for design work.

Mr. P. Winter has been elected executive director of Easiclene Porcelain Enamel (1938), Ltd., a member of the Owen organisation.

On 17th December the **Association of Supervising Engineers** held its Ladies' Night at the Connaught Rooms, London. A toast to the ladies was proposed by Mr. G. G. Kitchener, chairman of the Association, and an amusing response was made by Miss Patricia Hornsby-Smith, M.P. During the evening carols were sung by boys of the Tiffin School, Kingston-upon-Thames. There was also a cabaret show.

Mr. L. G. Lyon, a director and general manager of Superlamp, Ltd., is retiring this week after 40 years' service with the company. His colleagues presented him with a tape recorder at a farewell party.

Mr. E. F. Duncan, A.M.I.E.E., has been appointed manager of the Accessories Division, Prescot, of British Insulated Callender's Cables, Ltd., as from 1st January. Mr. Duncan was educated at Strathallan School and Glasgow University and, after a period of commissioned service in the Royal Signals, he trained as a contractor with James Kilpatrick & Sons, Ltd., Paisley. Joining B.I.C.C. at the end of 1952, he served with the Wiring Development Department for three years as an advisory engineer on special installations and then transferred to the Scottish Region as sales engineer for power cable systems and accessories before joining the Accessories Division at Prescot in 1957 as assistant to the sales manager. He was appointed divisional sales manager, Accessories Division, in 1959 and became deputy

Mr. E. F. Duncan

At the A.S.E.E. Ladies' Night: Miss Patricia Hornsby-Smith with Sir Josiah Eccles (left) and Mr. G. G. Kitchener (right) divisional manager last April. Mr. Duncan is a director of B.I.C.C.-Burndy, Ltd.

Mr. A. W. Page

Mr. A. W. Page, M.B.E., has been appointed sales director of Brookhirst Igranic, a member of the Metal Industries Group. He was previously general sales manager of the company. Mr. Page was born at Hove in 1914 and was educated at Hove High School and Brighton Technical College. He joined the old Igranic Electric Co., Ltd., at Bedford in 1934 and was made general sales manager when the company was merged with Brookhirst Switchgear, Ltd., in 1959. During the war Mr. Page served with the Royal Engineers, retiring as lieutenant-colonel.

Following the retirement of Mr. H. M. Lacey on 30th September, **Mr. R. H. Golde**, D.Sc., M.I.E.E., was appointed head of the Surges and Transformer Department of the Electrical Research Association and **Mr. M. Waters** has now been appointed deputy head of the Department.

Dr. Golde is known internationally for his work on the lightning performance of high-voltage systems and lightning protection of installations. With Dr. C. E. R. Bruce (E.R.A.) he received the Kelvin Premium in 1941 for a paper, "The Lightning Discharge." He is secretary of the Study Committee of Lightning and Surges of C.I.G.R.E., a member of the International Committee on Lightning Protection and of several B.S.I., I.E.E., and I.E.C. Committees. He was educated at the Technical University of Berlin. He joined the E.R.A. in 1935 and took his Ph.D. at Queen Mary College, London University, and was awarded the D.Sc.(Eng.) degree by the same University.

Mr. Waters received his early training with A. Reyrolle & Co., Ltd., and during his apprenticeship won the scholarship of the North East Coast Institution of Engineers and Shipbuilders which enabled him to proceed to King's College, Durham University, where he graduated with first-class honours in electrical engineering. He returned to Reyrolle's, working in the Research Department. After subsequent experience in power station construction with the Parolle Electrical Plant Co., Ltd., he joined the E.R.A. in 1946 to undertake research on power transformers. He is co-author of "Neutral Grounding in High-Voltage Transmission" and of two I.E.E. papers, one of which was awarded the Silvanus Thompson Premium. Internationally he is best known for his work on electromagnetic forces in transformers.

Mr. H. E. Forrest, A.M.I.E.E., technical engineer with the Hackbridge & Hewittic Electric Co., Ltd., left England recently for a five-week visit to India. He will be calling at Bombay, Madras and Delhi before returning to England via Colombo.

Following the retirement of **Mr. W. J. Richards**, chairman and chief executive of Johnson & Phillips (Australia) Pty., Ltd., and **Mr. F. N. Skinner**, managing director, **Mr. A. E. Woollaston**, formerly general manager, overseas, of Johnson & Phillips, Ltd., has been appointed managing director of the Australian subsidiary. Mr. Richards joined the J. & P. Australian organisation in 1928 and, after some years as general manager, was appointed chairman and chief executive of all the company's interests in Australia in 1949. Mr. Skinner is retiring for health reasons. He has been with the J. & P. Sydney branch for 29 years and was appointed managing director of J. & P. (Australia) at the beginning of 1959. Mr. A. E. Woollaston joined J. & P. in 1945. After service with the Bombay branch, he set up the J. & P. manufacturing branch in Karachi and in 1956 returned to London to take up the post of general manager, overseas.

The **British Central Electrical Co., Ltd.**, held their annual Christmas party, dinner and dance, for their staff and some of their old employees on 16th December at the Criterion Restaurant, Piccadilly, W.1, when about 80 people were present. The staff put on their own most amusing cabaret, in addition to the professional cabaret by Jean Tyler and Gordon Holdom, who sang delightfully. Mr. Gordon Conradi, A.M.I.E.E., M.D., presented a portable tape-recorder to Mr. R. Smith, stores and transport manager, in recognition of his 25 years' service.

The company's health was proposed by Miss Edith Cutting (Accounts Department), Mr. K. R. Cork, F.C.A., director, responding. The chairman, Mrs. J. F. Conradi, was unfortunately unable to attend, owing to an indisposition and a bouquet was sent to her on behalf of the staff. A bouquet was also presented to Mrs. Gordon Conradi.

Mr. B. J. Blackmore, technical sales representative with the British Central Electrical Co., Ltd., has been appointed as order department manager as from 1st January. Mr. Blackmore has been with the company for nearly eleven years; previously he was with the Southern Electricity Board.

About 130 members of the staff and guests attended the annual dinner of **Wandleside Cable Works, Ltd.**, at the Dog and Fox Hotel, Wimbledon, on 22nd December. In reply to the toast of the company proposed by Mr. C. Fletcher, one of the original employees of the firm, Mr. W. L. Wray, managing director, reviewed the prospects for the coming year. He referred to the "cable price war" which, he said, had hit the industry, and especially the leading concern, with great severity. "Price leadership" in the industry has not resulted in any advantages to bulk buyers of paper insulated cables and aluminium conductors in the way of competitive tendering, higher quality or better service. He trusted that none of the large manufacturers would precipitate another conflict. Finally Mr. Wray thanked the staff of Wandleside for their loyal support during the past most difficult year. Mr. T. G. Elliott proposed the toast of the guests, specially mentioning the ladies, and Mr. Scotcher responded.

OBITUARY

The late
Mr. L. P. Haussauer

Mr. Louis Paul Haussauer, founder, chairman and managing director of Aidas Electric, Ltd., died at his home in Ealing on 19th December; he was sixty-five. Mr. Haussauer was born in Geneva and came to Britain in 1916, setting up in business as a manufacturing jeweller. In 1923 he began making electric water heaters and in 1934 he pioneered low-cost electric water heating by the introduction of a 1½ gal heater designed to fit over the kitchen sink. Although in failing health for some time, Mr. Haussauer retained his interest in the business to the end. On the Friday before his death he was at the works completing the designs for a new model to be produced at his company's Salisbury factory. He leaves a widow, two sons and two daughters. His two sons, Messrs. E. J. and R. P. Haussauer, are both on the board of the company, the former being works director and the latter purchasing director.

Financial Section

STOCKS and SHARES

THERE is a marked contrast between the mood of almost unrestrained optimism in which the Stock Exchange began this year, and the atmosphere of caution which developed towards its close. Share prices broke all previous altitude records at the very start, but quickly began to lose buoyancy under the series of Government warnings about the dangers arising from excessive demands on the economy, and fell sharply when these were translated into the new credit squeeze. By mid-summer almost all of the lost ground had been recovered, but markets then resumed a steady decline as the evidence accumulated of serious difficulty in the trades most affected by the hire-purchase and other restrictions. On the average, share prices lost some 12 per cent of their value over the year. In the electrical markets there were inevitably some particularly severe casualties in the sections concerned with many sorts of domestic equipment, and the heavy divisions also fared poorly. Other branches however did well, so that the following tables of comparisons record a considerable variety of experiences.

Electrical Engineering

Shares of the major electrical groups again lacked support during the year. Depreciation of 33 per cent or more in the shares of A.E.I., English Electric and G.E.C. was much more than the average fall in industrials, and there were comparable declines in Babcock and Wilcox, Head Wrightson and others of the heavy engineering firms associated with them in nuclear power work. Unprofitable experiences in the latter field, coupled with the evidence of persistently narrow profit margins in some of the other main fields of operation, accounted largely for the lack of support for the shares; they were affected also, in the later part of the year, by difficult conditions for the domestic equipment manufacturing divisions. Crompton Parkinson and C. A. Parsons increased their dividends.

Company	Prices 1960		Chang
	Jan.	Dec.	
A.E.I.	64/–	40/6	–23/6
Crompton P. ...	14/3	11/3	–3/–
English Elec.	52/6	34/3	–18/3
G.E.C.	46/–(r)	29/9	–16/3
C. A. Parsons ...	58/6	47/–	–11/6
A. Reyrolle	49/–(s)	39/–	–10/–
Babcock & W. ...	48/–	33/3	–14/9
Clarke Chapman ...	59/–	45/–	–14/–
Head Wrightson ...	31/6	21/6	–10/–
Intl. Combustion ...	43/6	24/–	–19/6
Richardsons W. ...	14/9	6/6	– 8/3

Equipment and Manufacturing

In the general fields of electrical engineering, experiences varied a good deal but were relatively satisfactory on the whole. Crabtree Electrical had been among the outstanding successes of 1959 and again did better than most industrials in more than maintaining their value in 1960. Seven of the above ten companies increased their dividends. Plessey shares were affected by a £9½ million rights issue in the third quarter of the year and did particularly well therefore in finishing almost level with their opening price. Brook Motors also resisted the trend.

Company	Prices 1960		Chang
	Jan.	Dec.	
Bowthorpe	11/3	8/–	– 3/3
Brook Motors ...	50/–(s)	48/6	– 1/6
Crabtree Elec. ...	27/3(s)	29/–	+ 1/9
Dewhurst	8/6	7/–	– 1/6
Elec. Construction ...	37/3	32/–	– 5/3
Laurence Scott ...	17/3	16/6	– 9d
Plessey	48/9(r)	47/6	– 1/3
Ward & Goldstone ...	29/6(s)	27/–	– 2/6
West, Allen	15/6	11/6	– 4/–
Westinghouse ...	59/–	39/–	–20/–

Domestic and Other Equipment

Very mixed changes took place during the year in the shares connected with the motor-car, domestic equipment, radio and electronic industries. Appreciation of around 55 and 65 per cent respectively in Berry's Electric Magicoal (which had quadrupled their value in 1959) and Dimplex were feats equalled by very few shares in any department of the industrial market. Inevitably, however, the manufacturers of refrigerators, washing machines and television sets were among the least favoured groups, although even here there were good exceptions. The decline in Hoover was notably restricted in the circumstances, while in the radio and allied section Decca "A" more than held their ground, with the aid of another excellent annual report, and Ever Ready achieved a modest gain. Elliott-Automation shared the latter distinction but E.M.I. came down by about 20 per cent. Chloride Electrical did well in comparison with shares in the motor accessories section.

Company	Prices 1960		Change
	Jan.	Dec.	
Berry's Electric ...	32/–	49/6	+17/6
Bulpitts	21/3	16/6	– 4/9
Chloride Elec. ...	73/–	75/–	+ 2/–
Cole, E. K.	27/3(r)	20/–	– 7/3
Dimplex	28/–	46/6	+18/6
Decca "A"	50/6	51/9	+ 1/3
E.M.I.	54/3	43/3	–11/–
Elliott-Auto.	22/9(s)	25/–	+ 2/3
Ever Ready	28/3	31/6	+ 3/3
Goblin...	13/9	5/9	– 8/–
Hoover	51/6(s)	47/–	– 4/6
I.C.T.	77/6	61/–	–16/6
Lucas	74/–	61/–	–13/–
Pye	19/–	13/9	– 5/3
Radiation	44/–	29/6	–14/6
S. Smith	20/–	17/–	– 3/–
Thorn Elec.	55/6	45/–	–10/6

Cables and Telephones

Shares concerned with cable manufacturing have been influenced mainly by the degree of success achieved, under the lead of British Insulated Callender's Cables, in restoring the price levels of some of the main products to more economic levels. Several company statements have recently encouraged the view that the industry is over the worst of its troubles and that the benefit of better margins may appear during the course of the coming year. The net depreciation in B.I.C.C. shares was of the order of 20 per cent. Telephone manufacturers' shares followed the general trend. In making a recent "rights" issue, Ericsson reported a big improvement in orders this year.

Company	Prices 1960		Change
	Jan.	Dec.	
Aberdare Holdings ...	17/6	14/6	– 3/–
Aerialite	9/6	6/9	– 2/9
Auto. Telephone ...	21/6(r)	16/3	– 5/3
B.I.C.C.	60/6	48/3	–12/3
Dictograph	9/9(s)	8/6	– 1/3
Ericsson	28/6(r)	26/–	– 2/6
Hackbridge H'ldgs ...	8/3(s)	6/–	– 2/3
J. & P.	20/6	17/–	– 3/6
Pyrotenax	44/–	46/6	+ 2/6
Reliance Clifton ...	27/–	22/3	– 4/9

(s) Adjusted for scrip issues. (r) Price later affected by "rights" issues.

British Electricity Stocks

For much of the year the gilt-edged market was held down by the Treasury's policy of high interest charges. Despite the reductions in Bank Rate, Government stocks again lost ground and are finishing the year at the lowest levels. Falls in the five principal British Electricity issues were of the order of 5 to 8 points, the largest being in the 4¼ per cent stock dated 1974-79. A feature is the quotation of the two 3 per cent issues at prices nearly 26 and 30 points below their ultimate repayment values.

Yields on Shares

A combination of lower prices and fairly plentiful dividend increases has produced conditions in which the majority of industrial shares can be bought on a yield basis substantially higher than was possible a year ago. On some of the most favoured "growth" stocks, for instance Elliott-Automation and Thorn Electrical, yields are still well under 3 per cent, but returns in the range of 4 to 5 per cent are offered freely by good-class equities. Yields on some of the major electrical groups' shares have risen to about 6½ to over 7 per cent.

REPORTS and DIVIDENDS

Belliss & Morcom, Ltd.—The directors state that although the order intake continues to improve, the trend of unprofitable trading continued through the first half-year with consequent substantial losses in that period. The board is confident, however, that this trend has now been arrested.

In view of the results obtained this year to date there is no justification for declaring an interim dividend and "it is unlikely that the situation will have improved sufficiently to warrant a final dividend," adds the statement. A year ago there was a 3 per cent interim dividend but no final was paid for the year ended 31st March, 1960.

Burco-Dean, Ltd.—Group profits before tax were £211,472 for the year to 30th September, 1960, against the estimate last September of about £180,000, and the final dividend is at the minimum 10 per cent rate then forecast. The previous profit was £480,533. The final dividend makes the 1959-60 total 15 per cent compared with 18 per cent for 1958-59.

Pye and E. K. Cole.—The offer of British Electronic Industries, Ltd., for the stock of Pye, Ltd., and E. K. Cole, Ltd., has been accepted by the holders of over 90 per cent of the nominal amount of each class of stock and has been declared unconditional.

Oldham & Son, Ltd., are repeating their interim dividend at 7½ per cent for the year to 31st March, 1960—an effective increase of 2½ per cent adjusting for a one-for-two scrip issue. A total of 17½ per cent has been foreshadowed.

Dewhurst & Partner, Ltd., are paying a final dividend of 15 per cent, making 20 per cent, for the year ended 30th September, 1960. Profit after tax of £119,397 (£76,616) was £124,256 (£117,390).

Cambridge Instrument Co., Ltd., are paying a fourth interim dividend of 4 per cent (less tax), making 16 per cent (less tax) to date, compared with a total of 12½ per cent (tax free) last year.

Murex, Ltd., are paying an interim dividend of 5 per cent, compared with an equivalent of $4\frac{2}{7}$ per cent last year. This higher interim is not to indicate a higher total, which last year was $12\frac{6}{7}$ per cent including a bonus.

New Companies

Felwin Manufacturing Co., Ltd.—Registered 3rd November. Capital £100. Manufacturers of and dealers in lampshades and lighting fittings and electrical goods of all kinds, etc. Directors: W. Taffel and M. G. Lewin (secretary). Regd. office: 126, Wigmore Street, W.1.

K. Butterworth, Valley (Electric), Ltd.—Registered 7th November. Capital £1,000. Electrical engineers and general electrical installation contractors, etc. Directors: K. Butterworth and Marian Butterworth (secretary). Regd. office: Old Smithy, Mytholmroyd, nr. Halifax.

Jason Refrigeration Co., Ltd.—Registered 15th November. Capital £100. Importers, exporters, manufacturers and repairers of and dealers in domestic and household and commercial electrical appliances of all kinds including washing machines, dryers, refrigerators, etc. Solicitors: Howlett & Clarke, Brighton.

K. J. Shorey, Ltd.—Registered 11th November. Capital £1,000. To carry on the business of manufacturers of and dealers in vacuum cleaners, etc. Directors: K. J. Shorey and Norma Shorey. Secretary: Mrs. M. Clarke. Regd. office: 88, Ingleboro Drive, Riddlesdown, Purley.

R. Howe (Electrical), Ltd.—Registered 11th November. Capital £1,000. To acquire the business of an electrical contractor carried on by Ronald Howe at Stamford Street, Ashton-under-Lyme, etc. Directors: R. Howe and Doris C. Howe. Solicitors: Clayton Castle & Marks, Market Chambers, Radcliffe, nr. Manchester.

Simpson-Carr & Co., Ltd.—Registered 10th November. Capital £100. Electrical engineers and contractors, etc. Directors: L. K. Simpson and Mrs. Doris W. Simpson (secretary). Regd. office: 5/9, Wigmore Street, London, W.1.

Electric Appliances (Swansea), Ltd.—Registered 6th December. Capital £100. Dealers in and repairers and manufacturers of electronic, electrical and mechanical appliances, etc. Directors: D. B. G. Wignall and D. Dawson. Secretary: D. B. G. Wignall. Regd. office: 18a, Castle Street, Swansea.

W. Groves, Ltd.—Registered 5th December. Capital £3,000. To acquire the business of manufacturing electrical engineers carried on by W. Groves and Mrs. F. I. Groves at Balsall Heath, Birmingham, 12, etc. Directors: W. Groves and Mrs. Florence I. Groves (secretary). Regd. office: 9, Edward Road, Birmingham, 12.

Johnson Electrics (Worcester), Ltd.—Registered 6th December. Capital £2,000. To acquire the business carried on by P. E. Johnson at 2b, Farrier Street, Worcester, as Johnson Electrics and to carry on the business of industrial, automobile, marine and domestic electrical contractors, etc. Directors: P. E. Johnson, G. D. Johnson (secretary) and Kathleen B. Blundell. Regd. office: 2a, Farrier Street, Worcester.

F. R. Hammond (Electrical), Ltd.—Registered 6th December. Capital £1,000. Electrical, mechanical, radio, television, telephone and lighting engineers, etc. Directors: F. R. Hammond (secretary) and Mrs. Joan Hammond. Regd. office: 61, Grimsby Road, Cleethorpes, Lincs.

Universal Batteries (Surrey), Ltd.—Registered 5th December. Capital £2,000. Manufacturers of and dealers in batteries and component parts, etc. Directors: D. E. Haven, W. C. Brown (secretary), J. H. Brown and R. F. Viola. Regd. office: 1, Colnbrook Street, St. Georges Road, S.E.1.

Linyonne, Ltd.—Registered 22nd November. Capital £100. Manufacturers of and dealers in electrical goods, etc. Directors: K. Watson and Mrs. Nadine H. Watson (secretary). Regd. office: 12/13, Main Parade, Whitelands Avenue, Chorleywood, Herts.

Rider, Polge & Partners, Ltd.—Registered 7th December. Capital £1,000. Electrical contractors and engineers, radio, television and electronic engineers, etc. Directors: A. E. E. Polge, Judy B. Rider (secretary), K. Stonebridge, L. C. R. Dormer and R. Dormer. Regd. office: 120/121, Newgate Street, E.C.1.

Ramsta Electrics, Ltd.—Registered 7th December. Capital £100. Electricians, etc. Secretary: Shirley Hart. Regd. office: 713, Imperial House, Kingsway, W.C.2.

Esisolder Iron Co., Ltd.—Registered 7th December. Capital £100. Electrical contractors and engineers, etc. Directors: R. G. Rhode-Knight and Margaret Rhode-Knight. Regd. office: 9, Liverpool Gardens, Worthing.

Midland Electronics Engineering, Ltd.—Registered 17th November. Capital £1,000. Secretary: Shirley Hart. Regd. office: 36, Hazelwood Road, Northampton.

Ponteland Electricals, Ltd.—Registered 18th October. Capital £5,000. Directors: S. F. Jours and A. Costella. Solicitors: A. Neil McQueen & Co., Newcastle-on-Tyne.

Atkins Electrical Co., Ltd.—Registered 17th November. Capital £100. Electrical engineers and contractors; electronics, radio and television engineers, etc. Directors: R. F. Atkins and Mrs. Margaret S. Atkins. Secretary: Pamela E. Smith. Regd. office: 6, Russell Gardens, W.14.

Bankruptcies

W. E. Thomas, formerly carrying on business as Home Valet Service at 17, High Street, Hemel Hempstead, Herts., electrical appliance dealer, and **R. C. Green,** lately trading in partnership as Home Appliance Specialists, and formerly as Home Counties Electrical Services, at 15a, High Street, Hemel Hempstead, electrical appliance dealers.—First meeting held 20th December. Public examination 15th March at the Town Hall, St. Albans, Herts.

S. J. Bromilow, lately carrying on business as an electrical contractor at 148, North Road, St. Helens, Lancs.—Receiving order made 9th December on a creditor's petition.

A. H. Turner, trading as Light & Shade at 24, Crouch End Hill, London, N.8, electrical retailer.—Receiving order made 7th December on debtor's petition. First meeting 4th January and public examination 14th February at Bankruptcy Buildings, Carey Street, London, W.C.2.

F. J. Woods, lately carrying on business as an electrical goods retailer at 91, Market Street, Chorley, Lancs.—Receiving order made 13th December on debtor's petition.

H. Smith, lately carrying on business as an electrical engineer at the Old Bakery, South Clifton, Notts.—Last day for receiving proofs for dividend today (Friday). Trustee, Mr. N. Temple, 185, High Street, Lincoln.

W. B. McKelvey, electrical contractor, carrying on business at 2, High Road, Drayton, Norfolk.—Supplemental dividend of 1s 7⅝d in the £ payable at the Official Receiver's Office, Norfolk House, Exchange Street, Norwich.

J. G. Wadsworth, residing and carrying on business at 10, Westfield Terrace, Higham Ferrers, Northants., as the Nene Road Electrical Co., and formerly carrying on business at Nene Road, Higham Ferrers, electrical engineer and motor accessories dealer.—Receiving order dated 12th May, 1930, rescinded, all debts having been paid in full with 4 per cent statutory interest.

W. A. Badenoch, lately carrying on business with another as J. & B. Electrical Appliances at 11, Luton Road, Wilstead, Bedfordshire.—First meeting held 29th December. Public examination 14th February at the Shire Hall, Bedford.

Winding-up Orders

A.J.C. Electrics, Ltd., 297, Regents Park Road, London, N.3.—Winding-up order made 12th December.

Jacques (Electrical), Ltd., 10, Boome Street, Blackpool.—Winding-up order made 12th December.

S.A.L. Electrical, Ltd., "Caircant," Blakeney, Glos.—Winding-up order made 12th December.

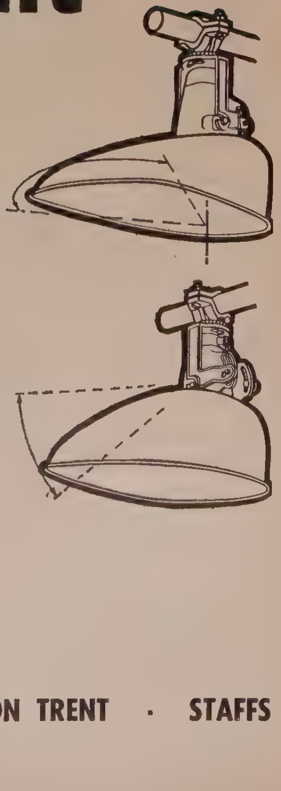
New area floodlight

. . . The Simplex Junior Reflecto Flood with six brighter-than-ever features ★ Low price ★ Fully weatherproof ★ Easily fitted to horizontal or vertical poles or by new Simplex bracket arrangements direct to wall ★ Adjustable cast aluminium brackets for precise angling of reflector ★ Lampholder and connections protected by die-cast aluminium body ★ Acid and alkali resistant vitreous enamelled reflector.

The Simplex Junior Reflecto Flood is suitable for 300/1500 W. GLS or 250/1000 W Mercury discharge lamps and is available in red, yellow, blue, grey or white.

Price from £10 10 0 complete in carton with bracket.

ELECTRICAL DIVISION



The Simplex reflector can be adjusted to the required angle.

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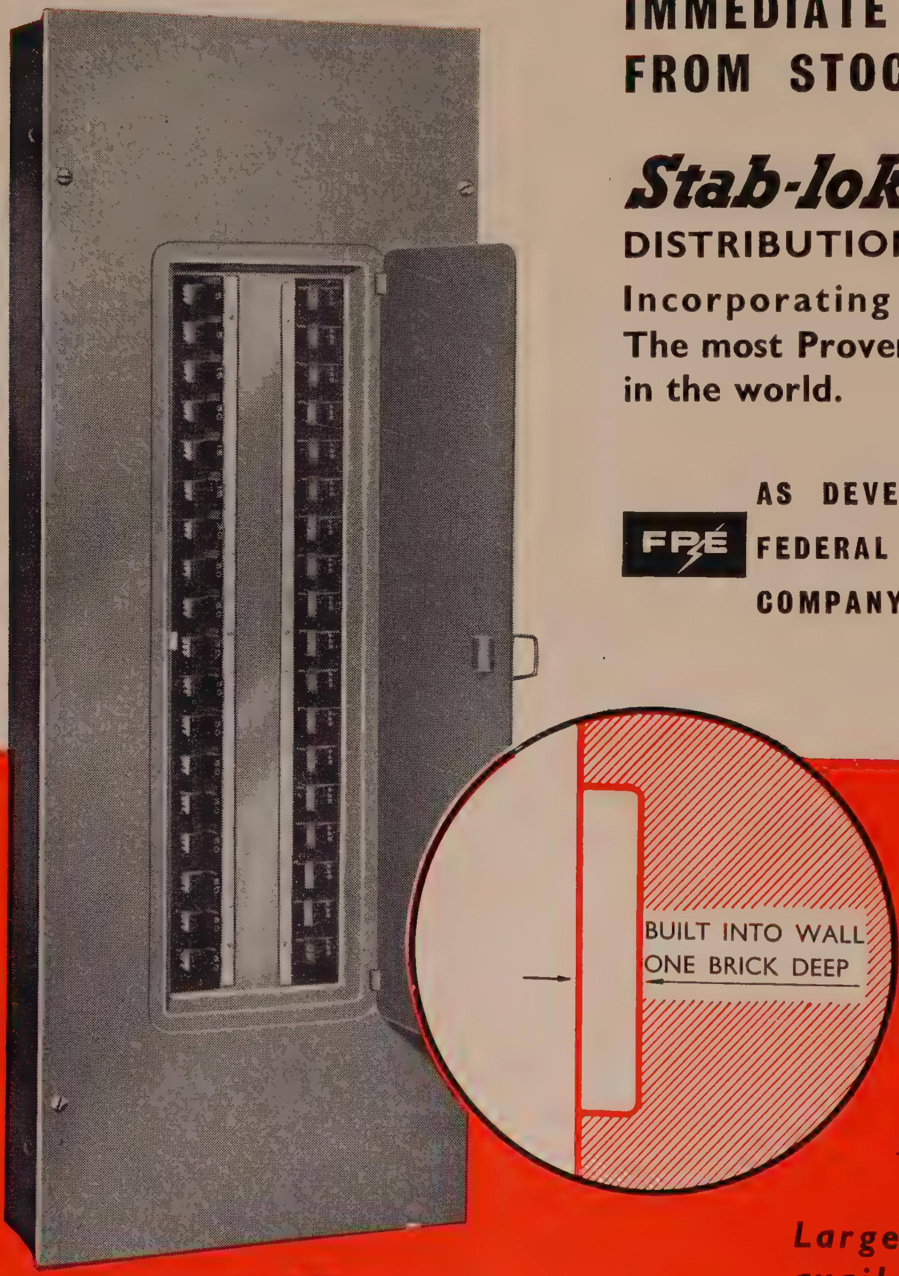

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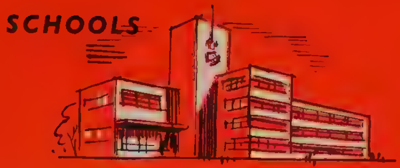
Larger power breakers available to 800 amps



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CONTACT MATERIALS

Their Grading According to Erosion Resistance

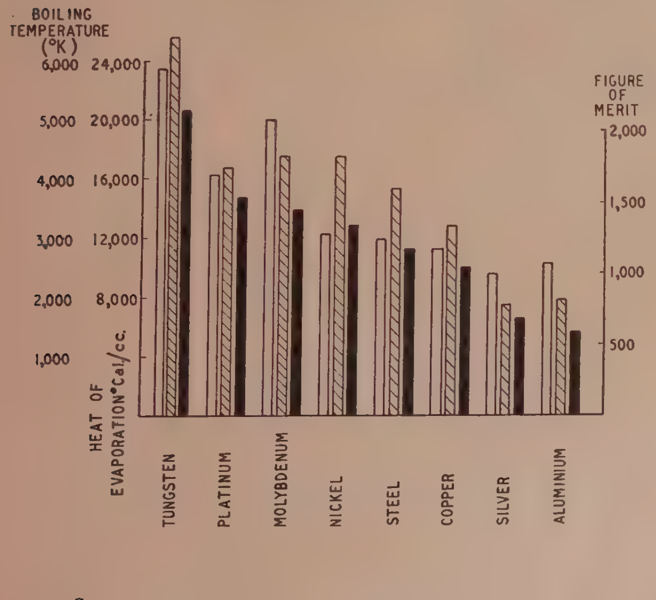
An ideal contact material should, among other properties, not experience wear due to the arcing which normally occurs during operation. The available materials, however, erode at different rates depending upon their physical properties, as well as the electric circuit in which they are incorporated. In this article an approximate relationship is suggested for grading contact materials according to their reluctance to erosion. It has been calculated for a number of metals and the results obtained confirmed by experimental investigations

By M. M. KHALIFA*
and
F. ABUL-MAKAREM†

MANY experiments have been carried out to compare contact materials by their rates of erosion due to arcing under various conditions for the electrical test circuit, the working ambient, and the contact design.[1,2,3] Also, some theoretical relationships have been suggested as criteria for the selection of contact materials.[1,4] Such relationships imply that the deciding factor is either the boiling temperature or the heat of evaporation of the contact material, and thus the higher its value, the lower would be the rate of erosion under the same operating conditions. This is not exactly correct, as can be seen in Fig. 1 where a number of contact materials are graded according to experimental results.[1,2,3] Fig. 1 indicates for each of the given metals, its boiling temperature, its heat of evaporation as well as its figure of merit as based on the present relation, by three lines from left to right.

It is noticed that although platinum was found to have better performance than molybdenum,[3] it has a lower boiling temperature, and a lower heat of evaporation (4,200°K compared with 5,070°K, and 1,700 against 1,850 calories per c.c.). The same phenomenon applies also to silver compared with aluminium, while molybdenum is found to be more reluctant to erosion than nickel although they have almost equal heats of evaporation and nickel is superior to steel which has almost the same boiling temperature.

Fig. 1.—Contact materials graded best to poorest (left to right) for wear resistance



A better criterion for grading contact materials is believed to be the amount of energy input at the arc terminal on the contact, per unit volume of metal evaporated. This amount of energy would be the sum of the heat consumed in evaporation, plus the heat radiated off the contact surface and that conducted within the contact material, as illustrated in Fig. 2. The arc voltage, which depends upon the contact material,[1] should be taken into consideration, because the higher the arc voltage for the same current, the greater would be the energy input from the arc to the contact.

For calculating the energy balance over the area of the arc terminal, the temperature is assumed to approximate the boiling temperature T_b of the contact metal[5] at the centre of this area, and to decrease radially to the melting temperature T_m at its rim. The temperature distribution was calculated and found to obey the approximate relation:—

$$T = T_b(1 - a\,r^2) \qquad \ldots\ldots(1)$$

where a is a constant characteristic of the contact material.

The surface area of the molten metal pool off which metal evaporates, the rate of metal evaporation and the corresponding rate of heat required for evaporation could be calculated. Using the calculated surface area, the relations for the rates of heat radiated to ambient and conducted heat within the contact material are obtained.

Thus, for energy balance, the input at the arc terminal would be equal to the sum of the heat of evaporation, the heat radiated and the heat conducted, as expressed by the following relation in calories per second, using C.G.S. units:—

$$\begin{aligned} P = {} & h\,[4{\cdot}4\times 10^3 \sqrt{2\pi M/RT_b}\; p\, k\,(1 - T_m/T_b)] \\ & + 3{\cdot}8\times 10^{-9}\,\delta\, k\, T_b^4\,[1 - (T_m/T_b)^5] \\ & + 207\, k^{2/3}\, T_b\,[2\,(1 - T_m/T_b) - (1 - T_m/T_b)^2] \ldots(2) \end{aligned}$$

where h is the heat of evaporation per gram of metal,

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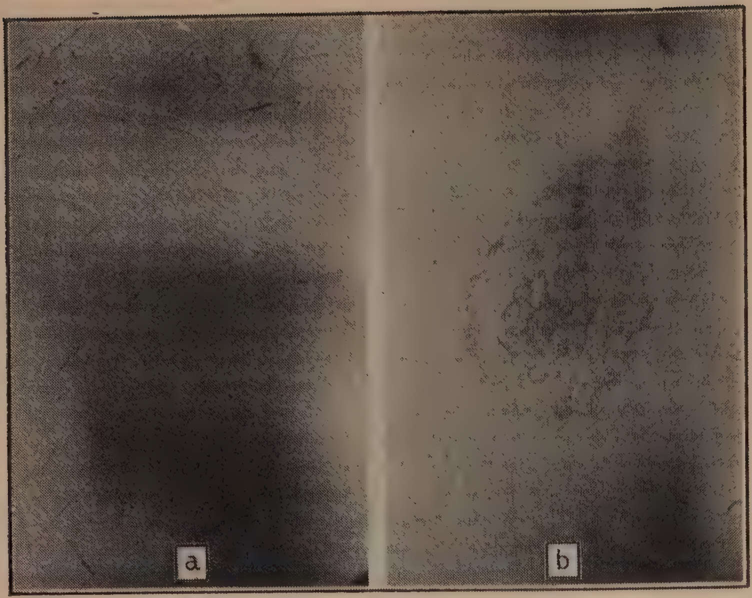
* University of Cairo, U.A.R. † Royal Institute of Technology, Stockholm, Sweden.



Left: Wear of contacts due to one arc of 550 A lasting for 0.2 msec. (a) Molybdenum contact. (b) Steel contact (X22.5)

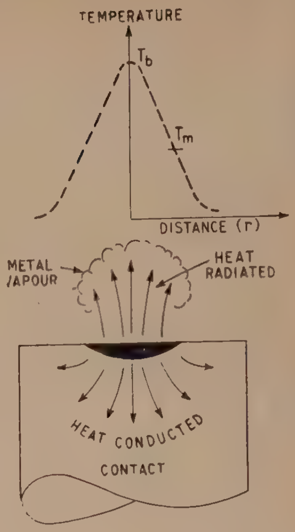


Fig. 2 (right).—Energy loss at the arc terminal on the contact

M is the metal's atomic weight, R is the universal gas constant, p is the ambient pressure, k is the thermal conductivity of the molten metal and δ is the emissivity of its surface.

The energy input per second P would result in the evaporation of a mass m of the contact metal per second expressed by the bracket of the first term of the relation (2). Dividing the power P by the value of this bracket, and multiplying it by the density γ of the contact metal, the energy input to the contact responsible for evaporating a unit volume of the contact metal is obtained. This input would be a function of the arc current times the arc voltage V_a. The latter was found to depend upon the contact material.[1]

Thus, the ratio $P\gamma/mV_a$ would give a measure of the current that evaporates a unit volume of the contact material over a certain period. It is, therefore, taken here as a figure of merit for the contact material, the greater its value, the lower would be the rate of contact wear under the same operating conditions. It could be calculated for any contact material by substituting its corresponding physical constants. This was done for many of the pure contact metals which were experimentally graded, and the values obtained for the figure of merit are plotted in Fig. 1. Although experiments were carried out on many contact alloys, they could not be included in this grading list, because their equivalent physical constants could not be accurately obtained. However, their constituent metals could be graded using the same present criterion.

The present figure of merit is believed to give the most accurate representation yet obtained for the heat transfer that accompanies arcing between the contacts, as influenced by most of the thermal properties of the contact material. This would be the reason for the better consistency with the experimental results.

Each of the metals given in Fig. 1 has the correct figure of merit relative to the other metals corresponding to its grade of excellence. Although these figures give the correct indication of the grade of the contact material as far as erosion is concerned, they would not give the exact amount of contact wear, as the latter is not mere metal evaporation but includes other phenomena which cannot be analytically computed. These include the condensation of metal vapour, splashing of molten metal droplets on the contact surfaces and bridge metal transfer.

The authors acknowledge the invaluable advice they received from Prof. Dr. M. A. El-Koshairy, secretary-general of the Electricity Commission, U.A.R.

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Heating Plant Controls

A PAPER entitled "Electrical Control of Heating and Air Conditioning Plant," by Mr. D. H. Powell, was read before a meeting of the Association of Supervising Electrical Engineers in London on 20th December. So that conditions of temperature and/or relative humidity are maintained within the spaces served by the plant, it is essential that adequate automatic control is applied to the plant. Mr. Powell defined an automatic control system as one in which the value of a controlled condition was compared with a desired value and corrective action was taken dependent upon the deviation in the closed loop formed by the comparing and correcting chains of elements. Such a system included a measuring unit, a controlling unit and a regulating unit, and the controlled plant.

SPIN AND TUMBLER DRYERS

Next week's issue will contain an illustrated domestic equipment supplement dealing with spin and tumbler dryers. The tabulated information will include size, clothes capacity, drum speed, exterior finish, price, and the names and addresses of makers or distributors. Combined washing machines/spin dryers will be included in the washing machine survey (17th February issue)

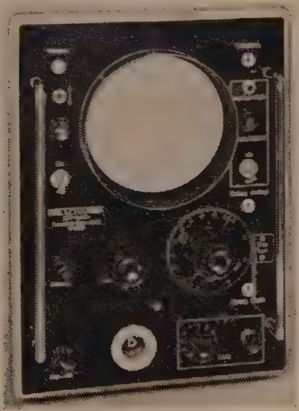
NEW ELECTRICAL EQUIPMENT

Ultrasonic Thickness Gauge

The Kretz ultrasonic thickness testing instrument, Series 6000, introduced recently to this country by Aveley Electric, Ltd., Ayron Road, Aveley Industrial Estate, South Ockendon, Essex, incorporates a high stability wide band amplifier having a frequency range of 3-20 Mc/s. It includes facilities for measuring dilation or contraction, and a triggering circuit gives warning when a predetermined limit of measurement has been reached.

Thickness measurements are obtained by spanning several pulses with a pedestal whose leading edge can be moved to divide the first cycle of each ringing pulse. The higher the number of echo-pulses used for measurement, the greater the discrimination obtained. The vertical deflection response of the trace is better than 0·05 μsec so that an echo-time discrimination of 0·0125 μsec is obtained.

The unit has an effective depth range from 1 to 70 cm for flaw detection, and for thickness gauging a maximum range of 20 mm dependent on frequency and attenuation of the material under test. The power rating is 180 VA. A low voltage socket is provided for certain types of work where stringent electricity safety precautions are essential. The use of this socket automatically makes the high voltage connection inoperative.



Aveley ultrasonic thickness measuring instrument

Stroboscope

A portable stroboscope tachometer designed by the General Radio Co. of America is now available from the sole United Kingdom representatives, Claude Lyons, Ltd., Valley Works, Ware Road, Hoddesdon, Herts. The type 1531-A "Strobotac" has a flashing rate adjustable from 110 to 25,000 flashes per minute, in three overlapping ranges, and accuracy is ±1 per cent of the dial setting. The range selection switch and control dial are concentric for ease of operation. Speeds of up to 250,000 r.p.m. can be measured using flashing rates that are submultiples of the speeds. The lamp is housed in a parabolic reflector which can be rotated through 360° horizontally and 180° vertically. The net delivered sterling price of the Type 1531-A is £156, inclusive of import duty, and delivery time at present is 6-8 weeks from receipt of order.

Portable stroboscope available from Claude Lyons, Ltd.

High Power Amplifiers

A range of public address and industrial amplifiers covering outputs of 30 W, 50 W and 1 kW is now being produced by Chapman Ultrasonics, Ltd., a member of the Derritron Electronics Group, 24, Upper Brook Street, W.1.

An amplifier on similar lines to the 1 kW unit which is in course of development will have an output of 5 kW and be suitable for supplying the driving power for electronic vibrators in the region of 2,000 lb thrust.

Laboratory Oven

The stainless steel chamber of the "Intermediate" oven announced by Baird & Tatlock (London), Ltd., Freshwater Road, Chadwell Heath, Essex, is 22in high by 19¼in wide by 18½in deep and is fitted with three removable shelves giving a total shelf area of 1,038 sq in and a total capacity of 7,936 cu in. The chamber temperature is controlled by a bi-metallic regulator, the operation of which is indicated by a pilot light. Temperature setting over the range 30-250°C can be achieved by a knob situated at the front of the oven. The overall size of the oven is 32in high by 24¼in wide by 22½in deep, and the weight is approximately 150 lb. The electrical rating is about 500 W at 100°C, and the maximum loading is 1,550 W. The oven is fitted with a 6ft lead with open ends and can be supplied for operation on 100-110, 115-120, 125-130, 200-210, 220-230 or 240-250 V, a.c./d.c. supplies. The price is £72 10s.

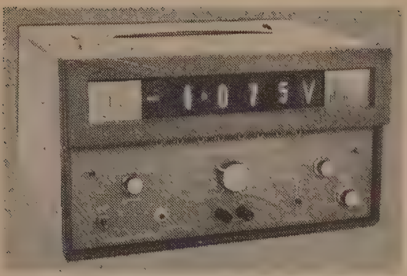
Inductance and Capacitance Meter

The MM 906 meter announced by Solartron Laboratory Instruments, Ltd., Cox Lane, Chessington, Surrey, is suitable for component checking and *in situ* measurements of inductance and capacitance. With minimum full-scale deflection ranges of 0 to 3 μH and 0 to 3 pF, this instrument provides a continuous monitor of inductance and capacitance from 0 to 300 μH and 0 to 300 pF respectively, in five ranges with ±3 per cent accuracy. This accuracy is maintained with resistance loads of 20 kΩ shunt, 10 Ω series on "Inductance" setting and 0·1 MΩ shunt on "Capacitance" setting. A "guard voltage," sufficient to drive to 200 pF, eliminates effects due to unwanted capacitances. Valve inter-electrode capacitances may be measured. The meter has a 4in scale and weighs 10 lb.

Solartron inductance and capacitance meter

Digital Volt-Ohm Meter

A fully transistorised digital volt-ohm meter has been added to their range by Venner Electronics, Ltd., Kingston By-Pass, New Malden, Surrey. This instrument is capable of measur-



Venner Electronics transistorised digital volt-ohm meter

ing d.c. and a.c. voltages from 1 mV to 1·1 kV, and resistance to 1·1 MΩ. The results are displayed by four in-line projection indicators, with automatic sign indication, and may be recorded by direct coupling to a printer or other equipment. The "DVOM" is suitable for operation as a single instrument, or for inclusion in any data logging system. It employs no stepping switches or relays, and consists of transistorised plug-in stages. The price is £385.

Miniature Rotary Potentiometer

The TP5 single turn miniature potentiometer which is now in production by MINIATURE ELECTRONIC COMPONENTS, LTD., The Lye, St. Johns, Woking, Surrey, has a maximum diameter of 0·5in and an overall length of 1·14in. It is capable of dissipating $1\frac{1}{2}$ W at 80°C; has a temperature range of -55 to $+150$°C, and is available in ten standard values ranging from 50 Ω to 50 kΩ. It is of miniature rotary wire-wound construction and fully sealed against climatic variation. The unit is mounted with a threaded bushing and the precision setting is secured by a collet locking device. It is made under licence from the Technology Instrument Corporation of California and Massachusetts.

Level Indicator and Controller

An instrument which gives continuous indication of the contents of silos, tanks, hoppers, etc., and also operates visual and/or audible alarms, has been announced by THOMAS INDUSTRIAL AUTOMATION, LTD., Station Buildings, Altrincham, Ches. Known as the "Levelrator," the equipment uses one electrode only for both continuous measurement and control. Alarm points can be set to operate over the full length of the electrode, which can be up to 60ft, to suit the particular application. The control unit, consisting of a stabilised power supply, alarm relay circuits and built-in calibrating instruments, is housed in a cast iron or sheet steel weatherproof case and can be situated up to 150ft from the electrode head unit. The calibrating instrument has a scale length of $2\frac{1}{2}$in and this is graduated in 2 per cent divisions and can be used as a local indicator. Remote indicators can also be supplied.

The equipment is available for operation from all standard mains voltages. The price for a "Levelrator" fitted with both high and low level alarms is approximately £100.

Multi-Point Recorder

A version of their electronic strip-chart recorder, the "Universal ElectroniK" multi-point recorder, enabling alternatives of 2, 3, 4, 6, 8, 10, 12, 16, 20 or 24 points to be measured and recorded on one instrument, is announced by HONEYWELL CONTROLS, LTD., Greenford, Middx. Variation is obtained by replacing the print wheel-cum-indicator dial, which is fixed by a thumb-tight nut, and replacing a shorting plug unit on a special input terminal board inside the instrument. The range of the instrument can also be changed by inserting new range resistor cards, and different types of measuring unit can be compensated for by using a new input terminal board. The Universal design can be supplied on any of the company's non-control strip-chart recorders.

Shaft Speed Transducer

A device to measure the speed of a rotating member without applying a load which might alter the speed of rotation, or where no physical connection is possible, is the electromagnetic transducer designed by the Electromechanical Division of ERICSSON TELEPHONES, LTD., Research Laboratories, Beeston, Nottingham. It has no moving parts and the whole unit is encapsulated in epoxy resin. It consists of a polarised electromagnet assembly with a large air gap. The poles of the electromagnet are mounted close to the rotating shaft so that any irregularity of the ferrous material (e.g. a bolt head, keyway, etc.) changes the reluctance of the air gap. This change causes a pulse in the output circuit which can be fed into any suitable electronic counter with or without amplification as necessary. By the choice of the correct number of gear teeth and using a time gated counter the transducer can be used as a direct reading tachometer.

The output pulse amplitude varies depending upon the frequency of the pulses and the gap between the pole pieces and the operating shaft irregularity, a typical characteristic being a rise in the peak output voltage from 0·4 to 3·2 V with a pulse frequency change from 1,500 to 9,000 c/s and a static air gap of 0·002in. The transducer is 2in long approximately and 1in in diameter over the mounting nuts. It weighs 64 grams, or 77 grams with the Belling Lee Type L789/FP connection plug.

Tax Removed from Electric Central Heating Appliances

UNDER Section 21 of the Finance Act, 1948, as amended, the Treasury have made the Purchase Tax (No. 5) Order, 1960 (S.I. No. 2351). This adds the following to the list of appliances exempted from tax under Group 12 of the Purchase Tax Schedule:—

(5A) Electrically operated appliances for central heating systems, being appliances designed for a sustained output, when installed, not less than 30,000 B.Th.U./hr (on the assumption, if the output varies with working conditions, that the appliance is working under average winter conditions), the following:—

(i) Water boilers;

(ii) appliances supplied with a system of ducting designed only for the transmission of heated air through such ducting to two or more rooms simultaneously.

The Order applies to electrically-operated domestic central heating appliances, i.e. appliances designed to supply heat from a central source, for distribution to the various parts of a house. The types of appliance that may qualify for exemption will include electrode and immersion heater types of water boiler, and hot air generators whether operated by a heat pump or by other means of electric heating.

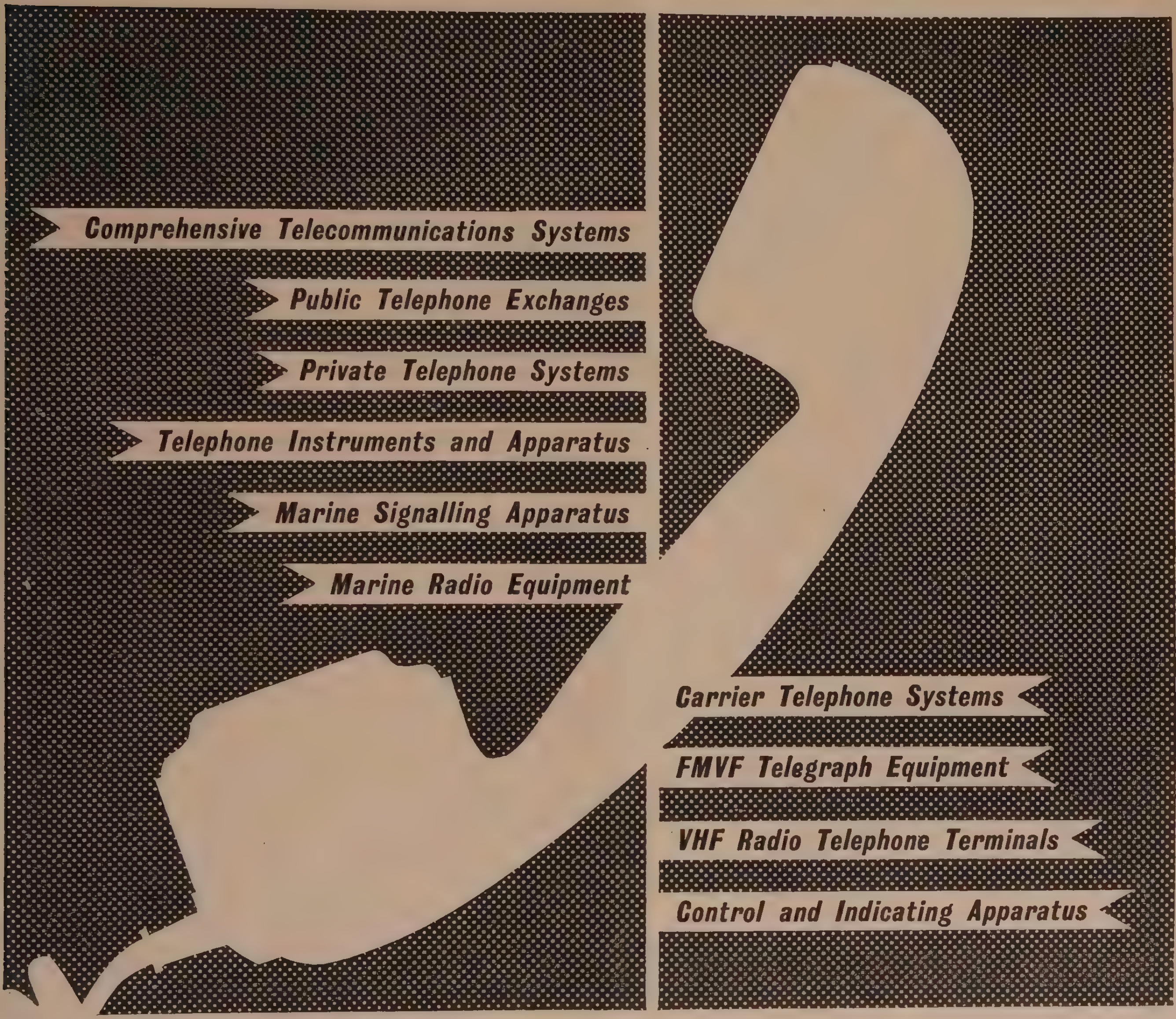
In the case of hot air generators the appliance should be designed only for the transmission of heated air through a system of ducting, and the appliance must be supplied with suitable ducting for that purpose.

Whatever the type of appliance, in order to qualify for exemption it must be designed to produce a sustained heat output of 30,000 B.Th.U./hr or more. The output of any appliance operated by a heat pump will vary to some extent with working conditions, and such an appliance should be capable of sustaining the required heat output when it is installed and working under average winter conditions.

Copies of the Order, which came into force on 21st December, are obtainable from H.M. Stationery Office, price 3d.

AEI

Telecommunications Division



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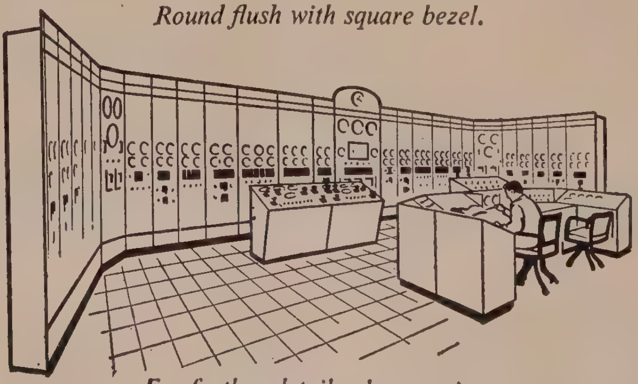

For further details please write to:

AEI

Associated Electrical Industries Ltd.
Instrumentation Division
Instrument & Meter Department
TRAFFORD PARK, MANCHESTER 17

G/A 705

NEW PATENTS

Electrical Specifications Recently Published

The numbers under which the specifications will be printed and abridged are given in parentheses. Copies of any specification (3s 6d each including postage) are obtainable from the Patent Office, 25, Southampton Buildings, London, W.C.2

1948

16020. Wood, W. F.—Nuclear reactors. 2nd June, 1949. (856922.)

1955

29914. Eastern Electricity Board, and Holland, E. A.—Crop dryers. 21st January, 1957. (856001.)

37319. Postmaster General.—Electric pulse train generating systems. 28th December, 1956. (856925.)

1956

1542. Black, G. A.—Controlling apparatus for use with electrical winding gear. 17th January, 1957. (856614.)

3683. Dubilier Condenser Co. (1925), Ltd.—Winding electrical units, for example capacitors. 26th April, 1957. (856583.)

5748. Electric & Musical Industries, Ltd. —Colour television cameras. 7th February, 1957. (856002.)

7573. General Electric Co., Ltd.—Automatic electric switching systems such as automatic telephone exchanges. 28th February, 1957. (856732.)

8321. Yorkshire Switchgear & Engineering Co., Ltd., and Caton, G.—Operating mechanism for electrical circuit-breakers. 13th March, 1957. (856874.)

8871. Telegraph Construction & Maintenance Co., Ltd.—Method of forming a joint between the ends of, or repairing, rods, tubes or the insulation of cable joints. 14th March, 1957. (856040.)

9444. Bone, S. J.—Electrified fences. 27th March, 1957. (856041.)

10195/6. Pilkington Bros., Ltd., and Hopwood, W.—High voltage insulators. 20th March, 1957. (856042/3.)

12510. British Dielectric Research, Ltd. —Electrolytic capacitors. 23rd April, 1957. (Addition to 715525.) (856927.)

13861. British Thomson-Houston Co., Ltd.—Temperature measuring arrangements forming thermal images of electrical apparatus. 26th April, 1957. (856044.)

14262. British Thomson-Houston Co., Ltd.—Devices for indicating the level of an electrically conducting liquid. 2nd May, 1957. (856004.)

18638. Plessey Co., Ltd.—Circuits for triggering synchronised oscillators. 17th June, 1957. (856045.)

18965. General Electric Co.—Production of silicon. 19th June, 1956. (856137.)

19835. Automatic Telephone & Electric Co., Ltd.—Signalling systems. 17th May, 1957. (856130.)

23746. Siemens Edison Swan, Ltd.—Automatic telephone and like selective systems. 24th July, 1957. (856971.)

27242. English Electric Co., Ltd.—Fuel element cans for nuclear reactors. 28th August, 1957. (856740.)

32112. Plessey Co., Ltd.—Electrical capacitors. 14th October, 1957. (856046.)

36239. Sparcatron, Ltd.—Apparatus for working electrically conductive materials by electric erosion. 23rd January, 1958. (856340.)

36448. Syntron Co.—Transducers. 28th November, 1956. (856131.)

37398. General Electric Co., Ltd., Rudge, T. R., and Taylor, K.—Instruments for indicating the magnitudes of magnetic fields. 6th December, 1957. (856384.)

38094. Mullard, Ltd.—Semiconductive devices. 13th December, 1956. (856430.)

38396. Morle, C. W. (Philco Corporation). —Automatic signal control systems. 17th December, 1956. (856140.)

38712. Laboratory for Electronics, Inc.—Apparatus for classifying unknown signal wave forms. 19th December, 1956. (856342.)

1957

6106. Varian Associates.—High frequency electron discharge tubes. 22nd February, 1957. (856973.)

7252. Weller, B. L.—Composite electrical components and methods of manufacturing same. 5th March, 1957. (856584.)

7800. General Electric Co., Ltd.—Method of and apparatus for testing electrical fusible elements. 17th February, 1958. (856744.)

8886. Zanardo, G.—Automatic answering and recording electronic apparatus suitable for association with calling circuits. 18th March, 1957. (856011.)

8968. Kokusai Denki Kabushiki Kaisha. —Electrical apparatus for measuring reactances. 19th March, 1957. (856586.)

9685. Kienzle Uhrenfabrieken A.G.—Electromagnetically wound clock. 25th March, 1957. (856811.)

9697. Philco Corporation.—Fluid-flow apparatus such as refrigerating apparatus. 25th March, 1957. (856012.)

9999. General Electric Co.—Tubular electric resonance radiation discharge lamps. 27th March, 1957. (Addition to 821321.) (856912.)

11381. Philips Electrical Industries, Ltd. —Electric gating devices. 8th April, 1957. (856014.)

11383. Philips Electrical Industries, Ltd. —Colour television cameras. 8th April, 1957. (856015.)

13354. Fernseh G.m.b.H.—Storage target for electron discharge tubes and discharge tubes containing such targets. 26th April, 1957. (856017.)

13549. Fernseh G.m.b.H.—Television apparatus. 29th April, 1957. (856936.)

13550. Rydbeck, O. E. H., and Stenhardt, C. M. E.—Electronic apparatus utilising a cathode-ray tube. 29th April, 1957. (856018.)

15596. Compagnie Industrielle des Telephones.—Toroidal coils. 16th May, 1957. (856146.)

15695. Alford, A.—Hybrid type impedance network. 17th May, 1957. (856030.)

16116. Hoover, Ltd.—Washing and/or drying machines combined with ironing boards. 14th August, 1958. (855965.)

17840. Standard Telephones & Cables, Ltd.—Arrangements for cooling the anodes of electron-discharge devices. 5th June, 1957. (856032.)

23432. Teleflex Products, Ltd.—Electric actuators. 9th May, 1958. (856160.)

24016. Siemens-Schuckertwerke A.G.—Regulating arrangements for steam power plants including a steam boiler having low storage capacity. 29th July, 1957. (856323.)

24070. Electro-Acid Corporation.—Electric storage battery. 30th July, 1957. (856187.)

24541. Thoma, J. U.—Magnetic separators. 1st August, 1958. (855928.)

25233. Sims, W. J.—Electrically heated irons. 7th August, 1958. (856257.)

28535. Pye, Ltd.—Transistors. 3rd September, 1958. (855969.)

28750. Diebner, K.—Process and plant for the thermal breeding of plutonium. 12th September, 1957. (856054.)

29036. J. A. Crabtree & Co., Ltd., Carding, J. T., and Jelley, G. A.—Contacts for electric switches. 10th September, 1958. (856056.)

29038. J. A. Crabtree & Co., Ltd., and Jelley, G. A.—Arc shields for multipole electric switches. (856057.) 29040. Electromagnetically operated motor starters. (856058.) 29041. Contacts for electric switches. 10th September, 1958. (856059.)

30912. Central Electricity Generating Board and Edley, W.—Control apparatus for boilers. 5th September, 1958. (856470.)

31157. Marconi Instruments, Ltd.—Stabilised current supply circuit arrangement. 11th July, 1958. (856206.)

31820. Licentia Patent-Verwaltungs-G.m.b.H.—Installation for testing high-power circuit-breakers. 11th October, 1957. (855970.)

32686. Mec-Test, Ltd.—Electrical null transmission networks. 15th October, 1958. (855991.)

35967. General Electric Co., Ltd.—Vacuum cleaners. 10th November, 1958. (856976.)

36736. General Electric Co., Ltd.—Brush-changing devices. 20th November, 1958. (857003.)

36887. Svenska Ackumulator Aktiebolaget Jungner.—Arrangements for supplying loads from electric batteries. 26th November, 1957. (856642.) 40220. Safety devices for series connected hermetically sealed battery cells. 27th December, 1957. (855935.)

37062. Hägglund & Söner A.B.—Snap-action electric switch. 28th November, 1957. (856945.)

38519. Siemens Edison Swan, Ltd.—Telephone systems. 9th December, 1958. (855995.)

38666. General Electric Co., Ltd.—Transistor oscillator circuits. 21st November, 1958. (856105.)

38676. Soc. d'Electronique et d'Automatisme.—Electric digital computer. 12th December, 1957. (856438.)

39043. Norton Grinding Wheel Co., Ltd. —Platinum or platinum alloy conductors particularly furnace heating elements. 4th November, 1958. (856309.)

39764. General Electric Co., Ltd., Davis, L. A., and Tompsett, L. C.—Manufacture of dynamo-electric machines. 22nd December, 1958. (856061.)

40337. Svenska Relafabriken A.B.—Electric control circuits. 30th December, 1957. (855997.)

1958

1528. Walther & Cie. A.G.—Fast breeder reactors. 16th January, 1958. (856946.)

2021. Tesla, Narodni Podnik.—Miniature electromagnetic relay for high switching frequencies. 21st January, 1958. (856164.)

2023. Zavody V. I. Lenina Plzen, Narodni Podnik.—Control systems for electric motors. 21st January, 1958. (856647.)

3135. Kablo-Bratislava, Narodni Podnik. —Symmetric high-frequency twin cable. 30th January, 1958. (855936.)

3752. Soc. d'Electronique et d'Automatisme.—Magnetic core circuits. 5th February, 1958. (856444.)

5373. Imperial Chemical Industries, Ltd. —Manufacture of coating compositions for electrical conductors. 23rd January, 1959. (856731.)

5434. Automotive Products Co., Ltd.—Centrifugally operated electric switches. 10th February, 1959. (856648.)

6928. Western Electric Co., Inc.—Wave generation circuits. 4th March, 1958. (856979.)

7842. British Insulated Callender's Cables, Ltd.—Electric cable couplings. 10th March, 1959. (856106.)

8457. General Electric Co., Ltd.—Circuit arrangements for operating electric lamps. 6th March, 1959. (855937.)

9028. M-O Valve Co., Ltd.—Low-pressure gas-filled thermionic valves. 20th March, 1959. (855998.)

[*Continued on next page*

9372. A.E.I.-John Thompson Nuclear Energy Co., Ltd.—Fuel elements for nuclear reactors. 19th March, 1959. (856839.) 13604. Fluid-cooled nuclear reactors. 27th April, 1959. (856950.)

9705. Tesla, Narodni Podnik.—Automatic exchange switch. 26th March, 1958. (856376.) 11047. Neutralisation of thermionic amplifiers. 8th April, 1958. (856000.)

9872. Metropolitan-Vickers Electrical Co., Ltd.—Electronic circuit components for digital computing apparatus. 21st May, 1959. (856980.)

11350. Pressac, Ltd.—Coaxial or screened socket. 7th April, 1959. (856481.)

12093. General Motors Corporation.—Manufacture of transistors. 16th April, 1958. (855973.)

12373. Western Electric Co., Inc.—Transistor circuits. 18th April, 1958. (856147.)

13119. General Electric Co., Ltd.—Electrostatic focusing devices for electron beams. 20th April, 1959. (856117.)

13781. Welwyn Electric, Ltd., and Whitfield, E. H.—Potentiometers. 16th June, 1959. (856843.)

14361. Babcock & Wilcox, Ltd.—Nuclear reactors. 5th May, 1959. (857009.)

14462 H. & B. Precision Engineers, Ltd. —Electronic timing device. 12th May, 1959. (856844.)

14722. Standard Telephones & Cables, Ltd.—Manufacture of electric cables. 1st May, 1959. (856069.)

14757. Babcock & Wilcox, Ltd.—Nuclear reactors. 8th May, 1959. (856213.)

14980. Deutsche Edelstahlwerke A.G., and Allgemeine Elektricitäts-G.m.b.H.—Method of and apparatus for reducing or preventing the damaging effect of shorting between the workpiece and electrode in spark-erosion machines. 9th May, 1958. (856251.)

16440. Schottle, H.—Electric domestic appliances for suction cleaning and polishing. 22nd May, 1958. (856485.)

17043. British Thomson-Houston Co., Ltd.—Seals for pressure vessels. 14th May, 1959. (856952.)

17342. Krizik-Karlin, Vyvojovy Zavod, Narodni Podnik.—Control systems for electric motors. 30th May, 1958. (856760.)

17677. Brown, Boveri & Cie. A.G.—Arrangements for regulating a multi-phase non-synchronous machine by means of a commutator regulating machine. 3rd June, 1958. (856673.)

17714. Shell International Research Maatschappij N.V.—Process for the preparation of electrical insulating oils. 21st March, 1959. (856887.)

17909. Marconi's Wireless Telegraph Co., Ltd.—Transducer coupling circuits arrangements. 2nd March, 1959. (856070.)

17910 British Insulated Callender's Cables, Ltd.—Multi-core electric power cables and their manufacture. 3rd June, 1959. (856782.)

18252. General Electric Co.—Rotor stage construction for axial flow compressors and turbines. 6th June, 1958. (856170.)

18463. Automatic Telephone & Electric Co., Ltd.—Pulse distributing arrangements. 4th May, 1959. (855975.)

18731. Marconi's Wireless Telegraph Co., Ltd.—Transmission lines. 19th February, 1959. (856889.)

19807. Compagnie des Compteurs.—Electromagnetic chopping relays. 20th June, 1958. (856891.)

21011. Automatic Telephone & Electric Co., Ltd.—Test circuits for group selectors in automatic telephone exchanges. 21st May, 1959. (856667.)

22498. Licencia Talalmanyokat Ertekesito Vallalat.—Process and equipment for the artificial cooling of electrical generators. 14th July, 1958. (856071.)

22641 and 22783. Licencia Talalmanyokat Ertekesito Vallalat.—Process and device for controlling an equipment for cooling electrical generators. 15th July, 1958. (856985/6.)

24050. British Thomson-Houston Co., Ltd.—Self-locking electric cable connector or plug. 30th June, 1959. (856171.)

24421. Electric Construction Co., Ltd.—Squirrel cage electric motors. 30th June, 1959. (856767.)

25497. Western Electric Co., Inc.—Electrical selector circuits. 8th August, 1958. (856148.)

28448. General Electric Co., Ltd.—Devices for producing light or infra-red radiation. 27th August, 1959. (856539.)

30669. Lindsley, T.—Utilisation of nuclear energy. 25th September, 1958. (856900.)

30852. British Thomson-Houston Co., Ltd.—Air or gas blast circuit-breakers. 13th August, 1959. (856291.)

30874. Thorn Electrical Industries, Ltd. —Gaseous discharge lamp circuits. 10th September, 1959. (856773.)

36607. Telefunken G.m.b.H.—Transistor oscillation generators. 13th November, 1958. (855985.)

39061. United-Carr Fastener Corporation. —Electrical connectors for electronic valves or the like having projecting terminal prongs. 3rd December, 1958. (856079.)

41067. Philips Electrical Industries, Ltd. —Method and apparatus for the inductive heating of workpieces. 19th December, 1958. (855987.)

1959

3762. High Voltage Engineering Corporation.—Electrostatic generator. 3rd February, 1959. (856025.)

4444. Mullard, Ltd.—Vacuum tubes. 9th February, 1959. (856123.)

4733. Allmänna Svenska Elektriska A.B. —Self-excited synchronous generators. 11th February, 1959. (855942.)

7287. Allmänna Svenska Elektriska A.B. —Means for supporting the relay armature and the contact mover on the relay frame in electromagnetic relays. 3rd March, 1959. (856353.)

10107. Allmänna Svenska Elektriska A.B. —Operating device for a pneumatic valve, in particular a blast valve for a circuit-breaker. 24th March, 1959. (856198.)

16276. Leece-Neville Co.—Alternator-rectifier generating systems. 12th May, 1959. (856908.)

18668. Aandewiel, C. J.—Hermetically sealed micro-switch. 1st June, 1959. (856222.)

19513. General Electric Co., Ltd.—Dynamo-electric machines. 1st July, 1957. (Divided out of 823788.) (856109.)

19854. General Motors Corporation.—Refrigerators and methods of making evaporators therefor. 10th June, 1959. (856477.)

20178. Electrolux A.B.—Speed regulating devices for electric motors and the like. 12th June, 1959. (856224.)

20470. Standard Telephones & Cables, Ltd.—Semiconductor assemblies with cooling arrangements. 15th June, 1959. (856855.)

20514. Avog Elektro- und Feinmechanik G.m.b.H.—Electric motors for windscreen wipers. 15th June, 1959. (856603.)

30435. Miwag Mikrowellen A.G.—Equipment for the suctioning-off of gases and vapour in microwave cookers. 7th September, 1959. (856919.)

30821. Matter, E.—Equipment for washing electrostatic precipitators. 9th September, 1959. (856864.)

TRADE MARK APPLICATIONS

APPLICATIONS have been made for the registration of the following trade marks. Objections may be entered up to 14th January.

Tungsram. No. 793,831. Class 7. Machines and machine tools for manufacturing electric lamps, radio valves, television tubes, etc.; electric motors (not for land vehicles); dynamos; electric welding machines; electrostatic generators; and vacuum pumps.—Egyesült Izzólámpa es Villamossági Részvény-Társaság, Budapest. Address for service: W. P. Thompson & Co., 12, Church Street, Liverpool.

Flexaway. No. B786,940. Class 9. Flex supports for electric flat-irons.—J. & P. Bruce, Ltd., 14, Trevor Place, Knightsbridge, London, S.W.7.

Goodmans. No. 789,637. Class 9. Electrical apparatus for magnetically generating mechanical vibrations.—Goodmans Industries, Ltd., Axiom Works, Lancelot Road, Wembley, Middlesex.

Lesco. No. 799,387. Class 9. Electrical switches and parts.—Lite Electrical Switch Manufacturing Co. (Proprietary), Ltd., Johannesburg. Address for service: Trade Mark Owners Association, Ltd., 15, Finsbury Circus, London, E.C.2.

Ulster Television (design). No. 796,376. Class 9. Electrical and electronic apparatus for use in television broadcasting.—Ulster Television, Ltd., 43, Donegall Street, Belfast.

Telerama. No. 799,664. Class 9. Television and radio apparatus, and apparatus for recording and reproducing sound.—Philco (Great Britain), Ltd., Romford Road, Chigwell, Essex.

Delatrol. No. 805,976. Class 9. Valves operated automatically by electric current control for use with scientific instruments.—Ether, Ltd., Tyburn Road, Erdington, Birmingham.

Darak. No. 807,348. Class 9. Electric battery separators.—Dewey & Almy, Ltd., Elvedon Road, Park Royal, London, N.W.10.

Lifeguard. No. 807,392. Class 9. Cathode-ray tubes for use in television and electronic apparatus.—Cathode Ray Tubes, Ltd., 758-60, Bristol Road, Selly Oak, Birmingham.

Collel (design). No. 808,294. Class 9. Sound receiving, reproducing, recording and amplifying apparatus, etc.—Collel, Ltd., All Saints Passage, Wandsworth High Street, London, S.W.18.

Golden Glide. No. 808,746. Class 9. Vacuum cleaners.—Singer Manufacturing Co., New York. Address for service: Cruikshank & Fairweather, 29, St. Vincent Place, Glasgow.

Solac. No. 809,368. Class 9. Electrical computing apparatus.—Solartron Electronic Group, Ltd., Solartron Works, Queens Road, Thames Ditton, Surrey.

Gussie. No. 799,999. Class 10. Equipment for medical or surgical purposes including infra-red and ultra-violet ray apparatus. —Great Universal Stores, Ltd., Devonshire Street, Hardwick, Manchester.

Philips (on shield). No. 796,505. All goods included in Class 11.—Philips Electrical, Ltd., Century House, Shaftesbury Avenue, London, W.C.2.

Bullet Light. No. 798,759. Class 11. Torches, electric lamps and electric lamp bulbs.—Ever Ready Co. (Great Britain), Ltd., Hercules Place, Holloway, London, N.7.

Discon. No. 803,550. Class 11. Lighting fittings for domestic or industrial use.—Simplex Electric Co., Ltd., Creda Works, Grindley Lane, Blythe Bridge, Stoke-on-Trent.

C (design including cross device). No. B804,433. Class 11. Parts of installations for lighting, heating, steam generating, cooking, refrigerating, drying, ventilating, etc.; carbons and carbon rods for electrical purposes, etc.—Société Le Carbone-Lorraine, Paris. Address for service: D. Young & Co., 9, Staple Inn, London, W.C.1.

Cona. No. 807,969. Class 11. Heating, cooking and refrigerating apparatus.—"Cona," Ltd., Felden Works, Railway Place, Wimbledon, London, S.W.19.

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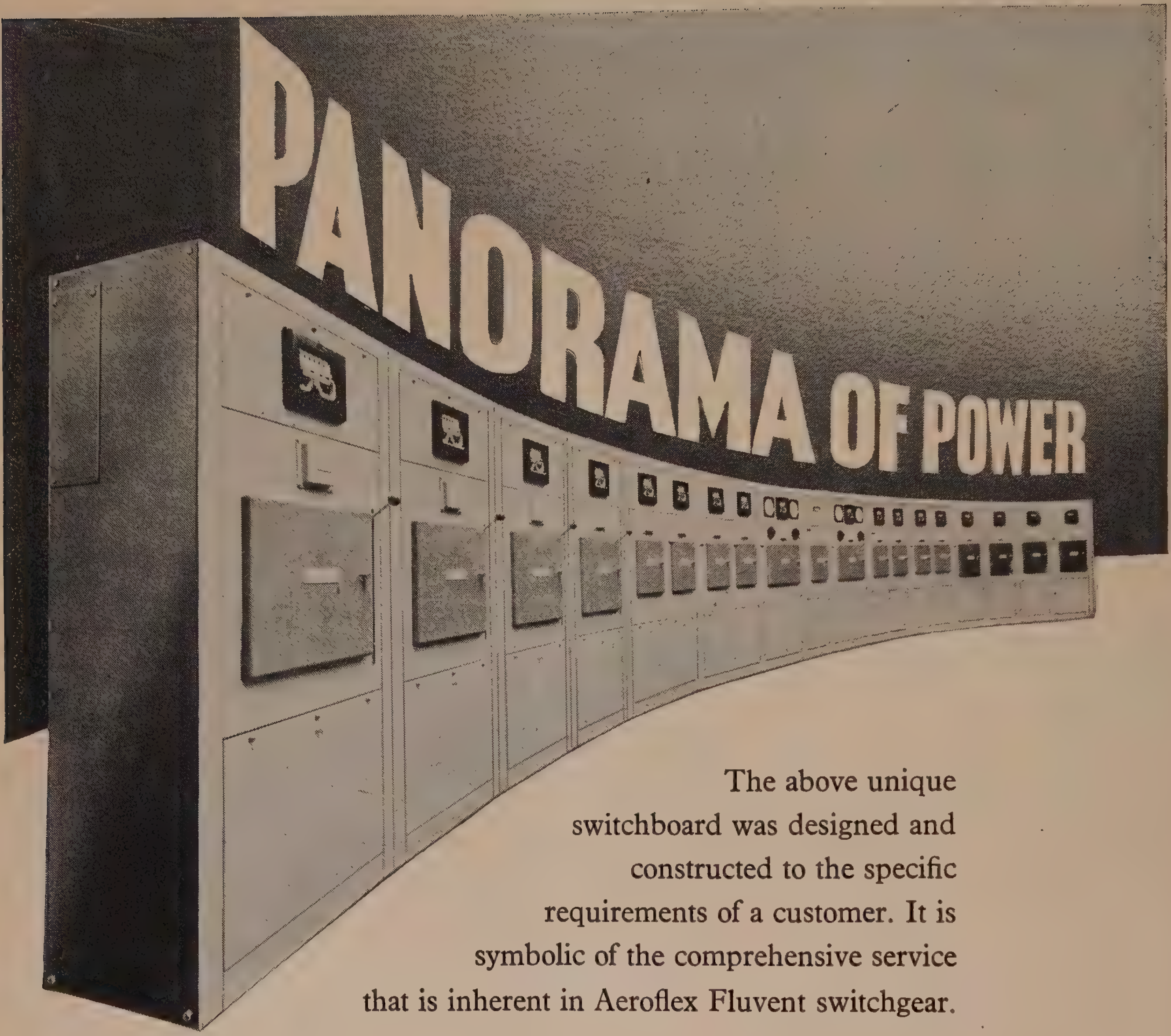

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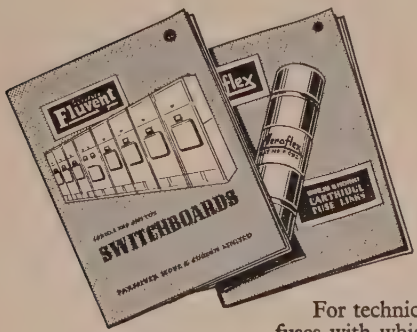

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PH 167

CONTRACT INFORMATION

Accepted Tenders and Prospective Electrical Work

CONTRACTS OPEN

Where "Contracts Open" are advertised in our "Official Notices" section the date of the issue is given in parentheses

Belfast.—City Council. 20th January. Stores for twelve months commencing 1st May, 1951. (See this issue.)

Chile.—Ferrocarriles del Estado. 10th January. Five electrical railcars. (E.S.B. 32850/60.)*

Doncaster.—R.D.C. 13th January. Trunk road lighting. (See this issue.)

France.—S.H.A.P.E., Paris. 15th January. Radio receiver and double-beam oscilloscope. (E.S.B. 32827/60.)*

Frimley and Camberley.—U.D.C. 21st January. Street lighting installation. (See this issue.)

Ghana. — Supply Commission. 16th January. Underground cables. (E.S.B. 32489/60.)*

Greece.—N.A.T.O. Infrastructure Contract. 25th April. F.m. radio link between Greece and Turkey. Applications to tender by 15th January. (G.D. 153/60(19).)†

India.—Punjab State Electricity Board. 31st January. 11 kV shunt capacitors. (E.S.B. 33157/60.)*

Italy.—N.A.T.O. Infrastructure Contracts. 27th February. Receiving assemblies for teletype dual diversity reception (Contract 9942); eight m.f. receivers (Contract 9943); and four facsimile recorders and three receivers (Contract 9944). Applications to tender by 5th January. (G.D. 1472/60 (76-7).)†

Korea.—Office of Supply, Seoul. 18th January. Power cable and rock drills. (E.S.B. 33174/60/I.C.A.)*

Leigh.—Borough Council. 5th January. Street lighting equipment. Borough engineer, Town Hall, Leigh, Lancs.

Linlithgow.—West Lothian County Council. 14th January. Trunk road lighting. (See this issue.)

London.—Westminster City Council. 12th January. Supply of electric lamps for one year from 1st April, 1961. Town clerk, Westminster City Hall, P.O. Box 141, London, W.C.2.

New Zealand.—G.P.O., Wellington. 30th January. Telephone cable. (E.S.B. 32829/60.)* 1st February. P.v.c. switchboard cable. (E.S.B. 32859/60.)*

Philippines.—National Power Corporation. 16th January. Additional load-end substation equipment. (E.S.B. 32884/60.)*

Singapore.—Central Electricity Board. 10th January. Main switch-fuse unit and isolators. (E.S.B. 33109/60.)*

Skipton.—U.D.C. 9th January. Rewiring of electrical installations. (See this issue.)

South Africa.—Union Tender Board. 13th January. Ten electric food conveyors. (E.S.B. 32835/60.)* 16th January. Transformers, motors, starters, voltmeters and ammeters. (E.S.B. 32834/60.)* 23rd January (postponed closing date). Equipment for conversion of 16-ton capstans to electric drive. (E.S.B. 29353/60.)* Durban Municipality. 10th February. Telephone wire. (E.S.B. 32845/60.)* 17th February. Telephone cable. (E.S.B. 32844/60.)* P.B.X. switchboards. (E.S.B. 32847/60.)*

South Vietnam.—Compagnie des Eaux et d'Electricité de l'Indochine, Saigon. 16th January (postponed closing date). Power plant equipment. (E.S.B. 31955/60/I.C.A.)*

United States.—U.S. Army District Engineer, Portland. 10th January (postponed closing date). L.v. switchgear. (E.S.B. 31999/60.)*

ORDERS PLACED

Brighton.—Corporation Entertainments and Publicity Committee. Recommended. Conversion of the Madeira passenger lift to a.c. operation (£1,110).—Marryat & Scott.

Douglas (I.o.M.).—Corporation Electricity Committee. 2,200 kW diesel generator set for Pulrose power station (£62,703).—Mirrlees, Bickerton & Day.

WORK IN PROSPECT

Particulars of new works and building schemes for the use of electrical installation contractors and traders. Publication in this section is no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors

Abercarn.—Houses (152), Trinant estate; Modern Building Co., Ltd., 24, Bridge Street, Newport, Mon.

Aylesbury.—Technical School and College of Further Education, Oxford Road; county architect, County Offices, Walton Street, Aylesbury.

Basingstoke.—Junior training centre and residential hostel (£42,000); county architect, The Castle, Winchester.

Bath. — Headquarters at Kingsmead (£55,000); Bristol Avon River Board, 18, Bennett Street.

Berkhamsted (Herts.).—Erection of second storey at Civic Centre and 200 houses on the Ashlyns estate; U.D.C. surveyor.

Billingham-on-Tees.—Reconstruction of ironworkers' shop and erection of new fabrication shed (£500,000); Furness Shipbuilding Co., Ltd.

Birmingham.—Arts centre, Canon Hill Park; H. Jackson, architect, 25, Augustus Road, Edgbaston.

Blackburn.—Rebuilding Waterloo Hotel, Penny Street; E. A. Hirst, architect, Star Brewery.

Brighton.—Bakery; Associated British Foods, Ltd., 40, Berkeley Square, London, W.1.

Cardiff.—Works, East Canal Wharf; Frixa, Ltd., West Canal Wharf.

Chelmsford.—Church and hall, Gloucester Avenue; Frank Deakin, architect, 79, Hillside Grove.

Houses (108), Beechenlea estate; Cooper Homes, Ltd., Wilmington House, Dartford.

Chertsey.—Administrative block, Addlestone Road, and two 12-storey blocks of flats, Addlestone; U.D.C. surveyor, Council Offices, Chertsey, Surrey.

Conway.—Hospital for sub-normal persons, Oakwood Park Hospital (£85,000); Architects' Division, Welsh Regional Hospital Board, Maesycoed Road, Rhiwbina, Cardiff.

Coventry.—Works, Charter Avenue industrial estate; Hibberd & Sons, Ltd., Warwick Street.

Durham.—Schools, Seaham, Wingate, and Winlaton; county architect, South Street, Durham.

Ealing.—Extensions and adaptations at Walpole Grammar School (£133,100); county architect, 1, Queen Anne's Gate Buildings, London, S.W.1.

Edinburgh.—14-storey building as replacement of Edinburgh Royal Infirmary; Robert Matthew & Johnston Marshall, architects, 31, Regent Terrace.

Exmouth.—Shop development, The Parade; Lincoln House Properties, Ltd., 45, New Bond Street, London, W.1.

Farnham.—Divisional police headquarters, Longbridge House site (£113,000); county architect, County Hall, Kingston-on-Thames.

Felling (Co. Durham).—Offices, cold store, etc., William Street, for Shepherd & Co., Darlington; Chippindale & Edmondson, architects, 37a, Tubwell Row, Darlington.

Flint.—Bungalows (39), Highfield site, Bagillt; borough engineer, Municipal Offices, Earl Street.

Gosport.—Flats (24), Trinity Green; borough engineer, The Hall, Trinity Green.

Grantham.—Factory, Dysart Road; Welland Manufacturing Co., Ltd., 2, Kings Newton Street, Leicester.

Hants.—Junior training centres at Aldershot and Alton; county architect, The Castle, Winchester.

Hastings.—Additional factory; C. & C. Marshall, Ltd., Theaklen Drive, St. Leonards.

Henley-on-Thames.—Flats (186), Paradise Row; T. R. Hancock, architect, 1, Church Lane, Wallingford.

Ipswich.—Secondary modern school, Chantry estate; Johns, Slater & Haward, architects, 32, Foundation Street.

Kettering.—High school for girls, Lewis Road (£265,135); county architect, County Offices, Guildhall Road, Northampton.

Lexden.—Rebuilding fire brigade workshops (£80,850); county architect, County Hall, Chelmsford.

London.—Depot, Frogmore, comprising three-storey welfare block, office block and mechanical repair workshop; J. Noel Martin, town clerk, Municipal Buildings, Wandsworth, S.W.18.

Office block, Coleman Street and Basinghall Street, E.C.; C. Lovett Gill & Partners, architects, 41, Russell Square, W.C.1.

Flats and maisonnettes (89), Alberta Street, Walworth; R. Mansell, Ltd., 17, Grant Road, Croydon.

Longbenton.—Houses (208), Dudley and Fordley; U.D.C. surveyor, Council Offices, Forest Hall, Newcastle-on-Tyne.

Market Harborough.—Houses and shops on new estate at Fleckney; R.D.C. surveyor, Market Harborough, Leics.

Middlesbrough.—Maternity and child welfare centre, Berwick Hills (£18,000); J. A. Kenyon, borough engineer.

Mill Hill.—Poliomyelitis research centre, The Ridgeway; H. H. Goldsmith, architect, 18, Gay Street, Bath.

Oldbury.—Dwellings (117), Lion Farm estate; borough engineer.

Ramsgate.—Industrial estate, Haine Road/Nash Road area; L. Hogbin & Partners, estate agents, 48, Queen Street.

Rugby.—Highways depot, Hunter Lane (£108,000); borough engineer.

Slough.—Houses (236), Parlaunt Park, Langley; borough engineer, Town Hall.

Southampton.—Workshop block, Millbrook School; Stinton Jones & Partners, consulting engineers, 43, Portland Place, London, W.1.

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* This information is extracted from the Board of Trade *Export Service Bulletin*. Inquiries should be addressed to the Board of Trade, Export Services Branch, Lacon House, Theobald's Road, London, W.C.2 (Telephone: Chancery 4411, Ext. 738), quoting the reference given. †Telephone: Trafalgar 8855, Ext. 2010.

Southend-on-Sea.—Two-storey gymnasium and assembly hall, cloakrooms, etc., Fairfax High School for Boys; borough architect, 30, Alexandra Street.

South Shields.—Fifty-four old people's bungalows and community hall near Wenlock Lodge (£93,000); J. Reid, borough engineer.

Sunderland.—Students' union and hostel accommodation for Sunderland Technical College (£368,500); Corporation Public Works Department.

Thornaby-on-Tees. — Proposed shops, Mandale Road, for Town Centre Securities, Ltd., Conway Road, Harehills Lane, Leeds, 8.

Uxbridge.—Meeting hall, Long Lane, Hillingdon; Harold E. G. Stripp, architect, 263, High Street.

Wallsend. — Junior school, Denbigh Avenue; W. B. Edwards & Partners, architects, 5, Claremont Buildings, Eldon Place, Newcastle-on-Tyne.

Walthamstow.—Extension, High School for Girls (£100,000); Tooley & Foster, architects, Midland Bank Chambers, Buckhurst Hill.

Warrington.—Maisonnettes (38), Mersey Street/Napier Street area; J. Y. Hughes, borough engineer, Town Hall.

West Bromwich.—Maisonnettes (184), in blocks of four storeys; Architect's Department, Hardware Street.

West Sussex.—Home for the aged, Henfield, and extensions to old people's home at Little Paddocks, Crawley (£35,400); county architect, County Hall, Chichester.

Whitley Bay.—Child welfare centre, Monkseaton; county architect, 30, Great North Road, Newcastle-on-Tyne.

Whitstable.—Houses (50), Swalecliffe Court estate; Fredk. J. Minns & Co., Ltd., Botley Road, Oxford.

STREET LIGHTING NOTES

During 1961-62 **Edinburgh** Works Committee proposes to convert gas street lighting to electricity at an estimated cost of £125,000. It is also to spend £50,000 on improving the lighting in streets already electrically lit and to install street lighting on new housing estates at a cost of £23,000.

Chislehurst and Sidcup U.D.C. is recommended to seek the approval in principle of the Ministry of Transport for carrying out street lighting improvements in 40 roads in 1961 at an estimated cost of £31,600.

Doncaster Highways and Public Works Committee plans to carry out stage IV of the gas lighting conversion scheme (Group "B"), during 1961-62, at an estimated cost of £13,240, and certain Group "A" schemes costing £10,000.

Longbenton (Northumberland) U.D.C. has accepted the tender of Engineering & Lighting Equipment Co., Ltd., for carrying out a further stage of the Council's programme for converting street lighting from gas to electricity.

Oxford Highways, Sewers and Lighting Committee reports that preliminary approval has been obtained from the Ministry of Transport for the proposed lighting of London Road with 280 W sodium lighting units at a mounted height of 35ft.

St. Andrews Town Council proposes to complete the conversion of the remaining gas street lighting in the town to electricity.

Aldridge (Staffs.) U.D.C. has approved a street lighting programme to be carried out in 1961 at an estimated cost of £7,620.

Further street lighting improvements are to be carried out at **Maidstone** during 1961-62 at a cost of £18,010.

Saltburn (Yorks.) U.D.C. is seeking Ministry sanction to borrow £23,406 for converting street lighting from gas to electricity.

Redcar Town Council is recommended to include £10,000 for street lighting improvements in its estimates for next year.

Wigston U.D.C. is to convert the remaining gas street lighting to electricity at a cost of £14,297.

NEXT WEEK'S EVENTS

Organisers of electrical functions are advised to make use of the "Electrical Review" clearing house, Room 221, Dorset House, Stamford Street, London, S.E.1, to ascertain that proposed dates for their functions do not clash with others already arranged

MONDAY, 2nd JANUARY

Birmingham.—James Watt Memorial Institute, 6.30 p.m. I.E.E. South Midlands Centre and Education Discussion Circle. "Broadening University Courses," by Dr. H. E M. Barlow.

Bennett Hall, Y.M.C.A., Snow Hill, 6 p.m. I.E.S. Birmingham Centre. Display of lighting fittings.

Leeds.—Great Northern Hotel, 7.30 p.m. A.S.E.E. Leeds Branch. "Application of Electricity to the Control of Oil Burners," by D. Stretton-Smith.

Prince of Wales Hotel, S.W.19. A.S.E.E. South West London Branch. New Year's party

London.—I.E.E., Savoy Place, W.C.2, 2.30 p.m. Plastics Institute. Young people's lecture on "Plastics and Textiles."

TUESDAY, 3rd JANUARY

Bolton.—Technical College, 3 p.m. I.E.E. North Western Centre. Christmas lecture for older schoolchildren. "Space Research by Rocket and Satellite," by Dr. R. G. Conway.

Leeds.—Leeds and County Conservative Club, South Parade, 6.30 p.m. I.E.E. North Midland Centre. "Water-Turbine Driven Induction Generators," by C. L. C. Allan.

London.—I.E.E. Lecture Theatre, Savoy Place, W.C.2, 3 p.m. Christmas lecture for young people. "Space Research by Rocket and Satellite," by Dr. R. L. F. Boyd. To be repeated on Wednesday, 4th January.

Eltham Green School, Queenscroft Road, Eltham, S.E.9, 7.45 p.m. A.S.E.E. South East London Branch. "Cables and their Uses," by D. Childs.

Windsor Castle Hotel, 134, King Street, Hammersmith, W.6, 7.45 p.m. A.S.E.E. West London Branch. "Marine Electrical Equipment," by M. Tuke.

Peterborough.—White Lion Hotel, Church Street, 7.30 p.m. Institution of Plant Engineers, Peterborough Branch. "Future Railway Development in Peterborough and District."

WEDNESDAY, 4th JANUARY

Edinburgh.—25, Charlotte Square, 7 p.m. Institution of Plant Engineers, Edinburgh Branch. "Heating," by A. A. Kidd.

Halifax.—Crown Hotel, Horton Street, 7.45 p.m. A.S.E.E. Halifax Branch. "Refrigeration."

London.—I.E.E. Lecture Theatre, Savoy Place, W.C.2, 3 p.m. Christmas lecture (see 3rd January).

London School of Hygiene and Tropical Medicine, Keppel Street, Gower Street, W.C.1, 6.30 p.m. British Institution of Radio Engineers. "Automatic Techniques in Civil Air Line Communications Systems," by W. E. Brunt.

Manchester.—Engineers' Club, Albert Square, 7.15 p.m. A.S.E.E. Manchester Branch. "Temperature Control," by A. P. Bellis.

Middlesbrough.—Cleveland Scientific and Technical Institution, 6.30 p.m. I.E.E. Tees-Side Sub-Centre. "The Fylingdales Early Warning Station," by D. R. Evans.

Preston.—R.A.F.A. Club, East View, 7.30 p.m. A.S.E.E. Preston Branch. "Lighting in Industry," by E. J. Smith.

Sheffield.—City Hall, 3 p.m. I.E.E. Sheffield Sub-Centre. "Colour Television," by Dr. R. Feinberg.

THURSDAY, 5th JANUARY

Chelmsford.—Hoffmann's Social Hall, 7.30 p.m. Chelmsford Engineering Society. "The Investigation of Radio Sources at Jodrell Bank," by Dr. H. P. Palmer.

Hove.—New Imperial Hotel, First Avenue, 7.30 p.m. A.S.E.E. Brighton, Hove and District Branch. "The I.E.E. Wiring Regulations," by R. E. Hunter.

London.—Savoy Place, W.C.2, 5.30 p.m. Institution of Electrical Engineers. "The Application of Electronics to the Electricity Supply Industry," by J. S. Forrest.

Manchester.—College of Science and Technology, 3 p.m. Christmas lecture (see Bolton, 3rd January).

Nottingham.—Electricity Centre, Carrington Street, 6 p.m. I.E.S. Nottingham Centre. "Light Effect on Dyes," by W. L. Lead.

FRIDAY, 6th JANUARY

Fawley.—Esso Refinery, 5.30 p.m. Society of Instrument Technology, Fawley Section. "Electronics and Instrumentation in the Glass Industry," by J. R. Beattie.

Liverpool. — M.A.N.W.E.B. Industrial Development Centre, Paradise Street, 7.30 p.m. A.S.E.E. Liverpool and District Branch. Discussion: "Aspects of Electrical Installations and Modern Building Construction."

London.—Savoy Place, W.C.2, 6 p.m. I.E.E. Medical Electronics Discussion Group. Discussion.

SATURDAY, 7th JANUARY

Salford.—Peel Park Technical College, 3 p.m. Christmas lecture (see Bolton, 3rd January).

CATALOGUES AND LISTS

FLOAT SWITCHES.—Brochure giving information on the "Hyflow" open cup and mercury glass tube types of float switches.—**A. Kingsley Williams,** Victory Works, Newbold Road, Chesterfield.

LAMPS.—Illustrated and priced catalogue (72 pages) containing particulars of Siemens-Ediswan general service, discharge and auto and battery lamps.—**Associated Electrical Industries (Woolwich), Ltd.,** 38-39, Upper Thames Street, London, E.C.4.

Leaflet listing a selection from the company's range of miniature and sub-miniature bulbs.—**Vitality Bulbs, Ltd.,** Neville House, Wood Green, London, N.22.

LIGHTING FITTINGS.—Pamphlet giving information on the company's "Bi-way" series of bowl refractors for use with fluorescent bulb mercury discharge and tungsten filament lamps.—**Holophane, Ltd.,** Elverton Street, London, S.W.1.

Illustrated 56-page catalogue dealing with industrial lighting fittings and a brochure containing examples of the lighting service offered by the Falk group of companies.—**Falk, Stadelmann & Co., Ltd.,** 91, Farringdon Road, London, E.C.1.

SCREWS.—Catalogue (57 pages) giving prices and particulars of cut-thread screws, bolts, nuts and washers turned from the bar. —**Davis & Timmins, Ltd.,** Billet Road, Walthamstow, London, E.17.

SIGNS.—Looseleaf reference book on "Moderneon" signs and lettering showing typical examples of signs produced by the company.—**Modern Electric (Installations), Ltd.,** 66-68, Brewery Road, London, N.7.

TEST EQUIPMENT.—A series of pamphlets dealing with the company's range of test equipment for automobile engine testing and tuning and including particulars of battery chargers and battery testers.—**Crypton Equipment, Ltd.,** Bridgwater, Somerset.

TRUNKING.—Illustrated folder (RN.1) giving details of rising main busbar trunking. —**Power Centre Co., Ltd.,** Lloyd Street, Wednesbury, Staffs.

CENTRAL ELECTRICITY GENERATING BOARD

TARIFF FOR BULK SUPPLIES TO AREA BOARDS

fixed by the Central Electricity Generating Board (the Generating Board) pursuant to section 37(1) of the Electricity Act, 1947, for the year ending 31st March, 1962.

NORMAL KILOWATT CHARGE

£7.7s.0d. (seven pounds seven shillings) for each kilowatt of the number ascertained by multiplying by 26,350,000

> the maximum number of kilowatts determined by deducting from the **half-hour kilowatt demand** supplied to the Area Board the **half-hour kilowatt demand of the special consumers** in the same half hour and adding the sum of the **nominated firm kilowatts** and the **excess kilowatts** (if any) of the **special consumers**

and dividing the product by

> the sum of the said maximum number of kilowatts for each Area Board and the chargeable kilowatts in the year of other direct consumers of the Generating Board.

RESTRICTABLE KILOWATT CHARGE

The above Normal Kilowatt Charge less £4.2s.0d. (four pounds two shillings) for each kilowatt of the sum of each maximum **half-hour kilowatt demand** of **special consumers** less the sum of their **nominated firm kilowatts** and less the sum of their **excess kilowatts** (if any).

For the above purposes—

(i) "**the half-hour kilowatt demand**" means twice the number of kilowatt-hours supplied in any half-hour between 7.0 a.m. and 7.0 p.m. on any Monday, Tuesday, Wednesday, Thursday or Friday, or between 7.0 a.m. and 12.0 noon on any Saturday in the year.

(ii) "**special consumer**" means a consumer of the Area Board who has agreed that (without prejudice to any statutory right which the Area Board may have to discontinue the supply of energy) his kilowatt demand can be restricted by the Generating Board for up to 2 hours on any occasion and up to an aggregate of 50 hours in the year provided that

- (a) The supply is afforded to the consumer's premises directly from a generating station or substation of the Generating Board through circuits not used for supplies to other consumers
- (b) The difference between the consumer's maximum **half-hour kilowatt demand** and his **nominated firm kilowatts** shall be not less than 25,000 kilowatts.
- (c) Suitable provisions have been made in respect of the costs of connection and the technical arrangements for operation, control, and metering, which may vary with local circumstances, and
- (d) Prior agreement has been made between the consumer the Area Board and the Generating Board in each case.

(iii) "**Nominated firm kilowatts**" means the **five-minute kilowatt demand** which in accordance with the above arrangements the **special consumer** is entitled to make during a period of restriction. For this purpose "**five-minute kilowatt demand**" means twelve times the number of kilowatt hours supplied to the **special consumer** in any consecutive five minutes.

(iv) "**Excess kilowatts**" means the amount by which the **nominated firm kilowatts** is exceeded by twelve times the largest number of kilowatt-hours supplied to the **special consumer** in any five minutes (excepting the first five minutes) during any period commencing when the Generating Board indicate (by a signal or otherwise) that they require his demand to be restricted in accordance with the above arrangements, and ending when the Generating Board indicate that normal supply may be resumed.

RUNNING CHARGE

0.42d. (decimal four two of a penny) for each kilowatt-hour supplied during the year, this charge to be increased or reduced by 0.00055d. (decimal nought nought nought five five of a penny) for each penny (a halfpenny or any greater part of a penny being treated as a penny) by which the fuel cost per ton in the year shall be above or below 60s. (sixty shillings).

For this purpose:

(i) "**Fuel cost per ton**" in any period shall be either

- (a) the quotient produced by dividing the aggregate of the product of the **Area fuel cost per ton** in the period and the **number of kilowatt-hours supplied from generation in the Area** in the period, and the product of the **residual cost per ton** in the period and **the number of kilowatt-hours imported into the Area** if any in the period by **the number of kilowatt-hours supplied in the Area** in the period; or
- (b) **the Area fuel cost per ton;**

whichever is the less.

(ii) "**The Area**" means the Area of the Area Board taking the supply.

(iii) "**The Area fuel cost per ton**" in any period shall be determined as follows: the total **cost of fuel consumed** in the period at all the Generating Board's stations in **the Area** shall be divided by the total number of tons of **fuel** so consumed and the cost per ton so obtained shall be multiplied by 11,000 and divided by the average gross thermal value of **fuel** so consumed expressed in British thermal units per pound.

(iv) "**Fuel**" shall mean coal, coke and oil fuels but shall not include atomic fuels.

(v) "**The cost of fuel consumed**" shall mean the sums expended for **fuel** consumed plus the cost of any transport, handling preparation or treatment incurred in connection with the delivery of the **fuel** to boiler hoppers or furnaces and in connection with the disposal of the products or residues of combustion, together with the proper proportion of salaries and wages and any contributions for pensions, superannuation and insurance of officers and servants attributable thereto and the amount of any rebate allowed by the suppliers from the price of heavy fuel oil delivered at the Generating Board's stations, such rebate being attributable only to a specific quantity of heavy fuel oil so delivered, **less** any sums received from the sale of any products or residues of combustion.

(vi) "**The number of kilowatt-hours supplied from generation in the Area**" in any period means the number of kilowatt-hours (being kilowatt-hours generated by the combustion of **fuel**) sent out from all the stations of the Generating Board in **the Area** in the period or **the number of kilowatt-hours supplied in the Area** in the period whichever is the less.

(vii) "**The number of kilowatt-hours supplied in the Area**" in any period shall mean the number of kilowatt-hours supplied in the period by the Generating Board to the relevant Area Board and to other consumers in **the Area**.

(viii) "**The number of kilowatt-hours imported into the Area**" means the amount if any by which **the number of kilowatt-hours supplied in the Area** exceeds **the number of kilowatt-hours supplied from generation in the Area.**

(ix) "**The residual cost per ton**" in any period shall mean the aggregate of—

- (A) The quotient produced by dividing the amount by which **the national fuel cost per ton** in the period multiplied by the aggregate of **the number of kilowatt-hours supplied in the Area** of each Area Board in the period exceeds the aggregate of the respective products in the case of each Area Board of (a) **the Area fuel cost per ton** in the period and (b) **the number of kilowatt-hours supplied from generation in the Area** in the period, by the aggregate of the **number of kilowatt-hours imported into the Area** of each Area Board in the period; and
- (B) the sum of 6s. (six shillings).

(x) "**The national fuel cost per ton**" in any period shall be determined as follows: the total **cost of fuel consumed** in the period at all the Generating Board's stations shall be divided by the total number of tons of **fuel** so consumed and the cost per ton so obtained shall be multiplied by 11,000 and divided by the average gross thermal value of the **fuel** so consumed expressed in British thermal units per pound.

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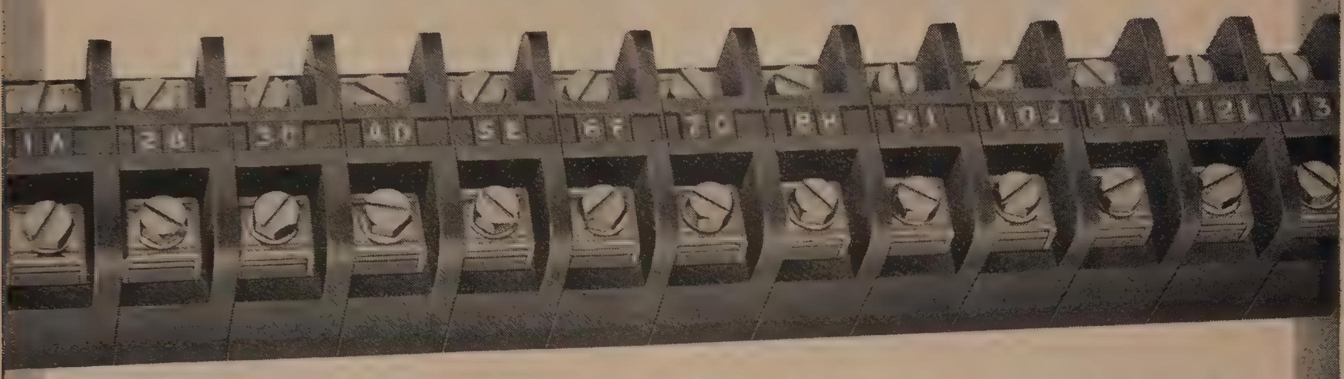

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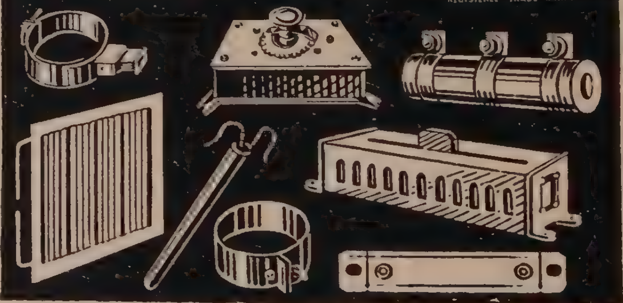

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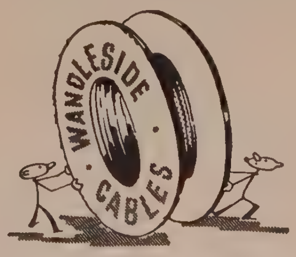

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WANDLESIDE WARREN WIRE CO. LTD. &
WANDLESIDE NATIONAL CONDUCTORS LTD.

WANDLESIDE CABLE WORKS LTD., 106 GARRATT LANE, WANDSWORTH, LONDON, S.W.18
Tel: VANdyke 7544 (7 lines) (In FALKS Group) Teleg: Wandleside London

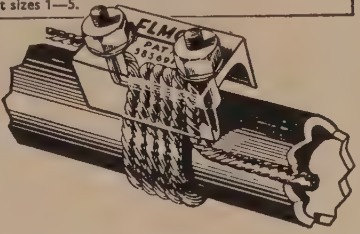
"ELMO"

EARTHING CLAMPS

A COMPLETE RANGE TO B.S.951. 1948

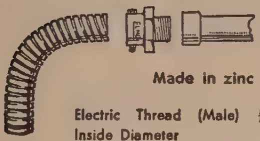
IN 4 SIZES	A123	B45	C67	D8910
for earthing cables up to	7/0.036"	7/0.064"	19/0.064"	19/0.083"
to fit B.S. conduit sizes	1, 2 & 3	4 & 5	6 & 7	8, 9 & 10
i.e. in trade terms	½" to ¾"	1" and 1¼"	1½" and 2"	2¼" to 3½"

NOTE ALSO: Type A123 is suitable for Earthing Cables up to 7/0.029" and for B.S. conduit sizes 1—5.



"Elmo" Earthing Clamps are of robust construction. Impossible for wire to pull out, always under tension, therefore a most satisfactory earth and a permanent safeguard.

ELECTRICAL FITTINGS



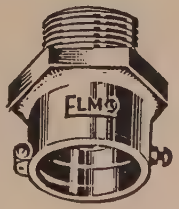
Flexible-to-rigid

CONDUIT COUPLINGS

Made in zinc base alloy in the following sizes:

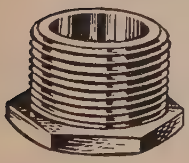
Electric Thread (Male)	⅝"	¾"	1"	1¼"	1½"	2"
Inside Diameter	⅝"	¾"	1"	1¼"	1½"	2"

Electric Thread (Male)	⅝"	¾"	1"	1¼"
Inside Diameter Flexible Conduit	½"	⅝"	¾"	1"



WITH EARTHING TERMINAL

Special Features: Integral Earthing Terminal, tinned ready for soldering. Fixing screw for continuity. Internal Threads suit all makes of flexible tubing.



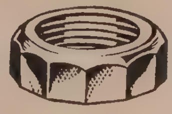
MALE
Hex. Section

CONDUIT BUSHES

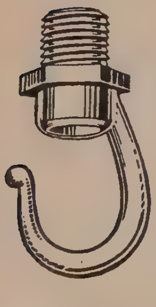
Made in the following sizes:

MALE: Electric Thread
⅝" ¾" 1" 1¼" 1½" 2"

FEMALE: Electric Thread
⅝" ¾" 1" 1¼" 1½" 2"



FEMALE
Flat Face Section for Spanner (except ¾" size, which is round)



CONDUIT HOOK

For fluorescent lamps and overhead lighting fittings. Screwed ¾" thread, male electric.

CEILING PLATE

One hook

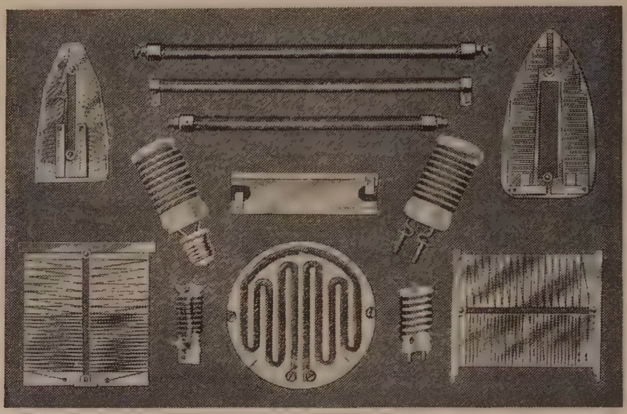
Made to fit all standard boxes with two holes 7/32" diameter —2" centres diametrically opposed. Designed in accordance with British Standard Specification.

Manufactured by M. MOLE & SON LTD.
BIRMINGHAM · 3 · ENGLAND Est. 1835

---

dependable
ELEMENTS
for every job

Stocked by Leading Wholesalers

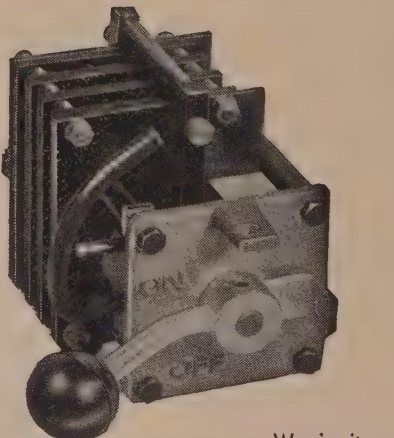


THE
ELECTRIC ELEMENTS CO.
Tokenhouse Yard, **NOTTINGHAM**
Makers of Elements since 1921

"Colne"

ISOLATOR SWITCHES

660 v. 60 ampere capacity A.C. with door interlock mechanism.



We invite your enquiries

Manufactured by
ASQUITH ELECTRICS (Colne) LTD.
formerly Colne Switchgear (K. & W.) Ltd.
Walton Street, Colne, Lancs.
Telephone: Colne 1394/5

Self-bonding WIRES

. . . a product of **F.D. SIMS LIMITED**

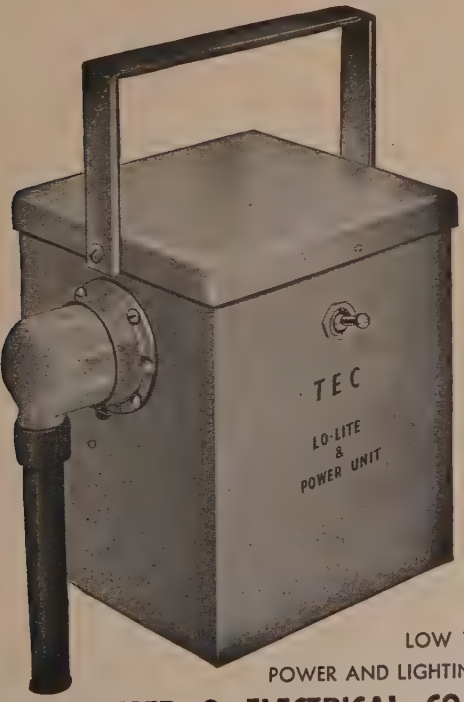
P.O. Box 8, Hazelhurst Works, RAMSBOTTOM, via Bury, Lancs.
Telephone: Ramsbottom 2213/4/5 *Telegrams:* "SIMS" Ramsbottom
London Office and Stores:
106 Newlands Park, Sydenham, London, S.E.26
Telephone: SYDenham 4211/2

S55

Insist on

T.E.C.

ELECTRONIC CONTROL EQUIPMENT, POWER AND DISTRIBUTION TRANSFORMERS TO 100 kVA, LOW VOLTAGE, FLASH TEST, RECTIFIER AND DENTAL PLATING UNITS, METAL WORK, TRANSFORMER REPAIRS AND CHOKES



Leaflets on request

LOW VOLTAGE
POWER AND LIGHTING UNITS

The TRANSFORMER & ELECTRICAL CO. LTD.
HONYWOOD RD., BASILDON, ESSEX
Telephone: Basildon 20491/3

ADCOLA PRODUCTS LIMITED
(Regd. Trade Mark)
SOLDERING EQUIPMENT

HIGHEST ELECTRICAL STANDARDS COMPLIED WITH

Illustrated

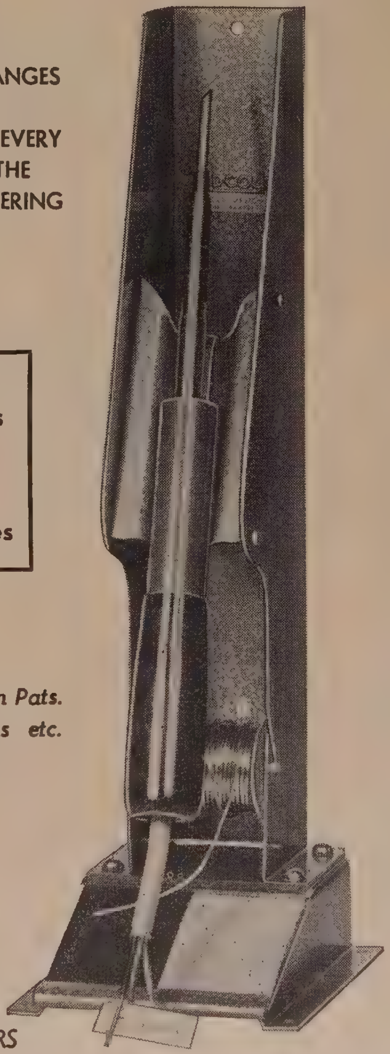
LIST No. 70 ⅛" BIT POSITIONED IN THE ADCOLA COMBINED PROTECTIVE SHIELD LIST 700

FOR CONTINUOUS BENCH LINE PRODUCTION

SUPPLIED
IN ALL VOLT RANGES
AND
A DESIGN FOR EVERY
PURPOSE IN THE
MINIATURE SOLDERING
INDUSTRY

The instruments with the correct soldering temperatures

British and Foreign Pats.
Registered designs etc.



APPLY
FULL PARTICULARS

ADCOLA PRODUCTS LTD.
HEAD OFFICE
GAUDEN ROAD, CLAPHAM HIGH ST.,
LONDON, S.W.4

Telephones:
MACaulay 4272 & 3101

Telegrams:
"SOLIJOINT," LONDON

"Zephyr" shaded pole motors | "Bestfrend" series motors

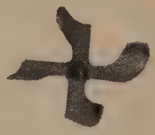
25 w. at 2,500 r.p.m. | 25 w. at 4,500 r.p.m.

Motors suitable for Fans · Fan Heaters
Hairdryers · Valve Cooling · Projectors Etc.

Precision built and specially suitable where silence is essential

REPAIRS

to "BESTFREND" Hairdryers undertaken. A NEW Model will shortly be available



FANS

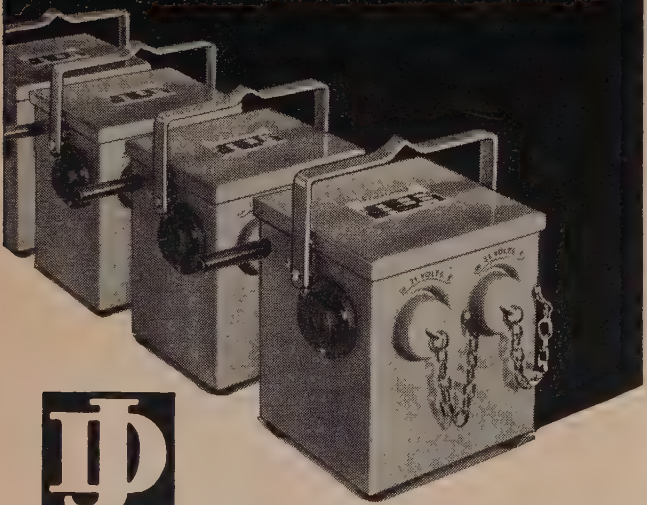
A 4 bladed 4″ diam. fan suitable for "ZEPHYR" motors

T. A. BOXALL & CO. LTD.

20 Balcombe Road, Horley, Surrey

Telephone: Horley 4388

PORTABLE TRANSFORMERS



IJD

SIZES AVAILABLE
60·120·250·500·750·1,000 VA
PRIMARY VOLTAGES
200/250 VOLTS
SECONDARY VOLTAGES
12·25·50·110 VOLTS

JOHN DRUMMOND (ENGINEERS) LTD

BELLCRAG WORKS, Dalsholm Road, GLASGOW N.W. Tel: MARyhill 3315/6

---

specify *Sheen* cable jointing equipment

Registered design pending

This meets all the requirements of Local Authorities and Main Contractors. Of sound design and robust construction — it is manufactured by a Firm with many years experience in this type of equipment. *We recommend Propagas Propane as supplied by Shell-Mex and B.P. Gases Limited for use with all our equipment.*

For details apply to
SHELL-MEX AND B.P. GASES LIMITED
Cecil Chambers 76-86 Strand WC2.

Sheen (Nottingham) Ltd
Greasley Street
Bulwell, Nottingham
Telephone 27-1437

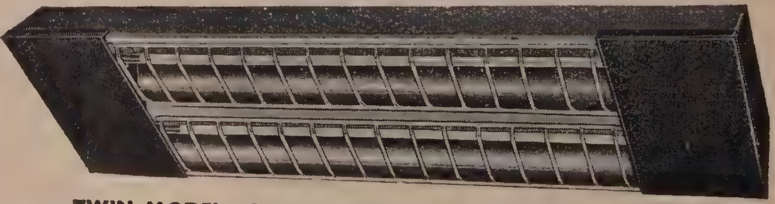
USEEKIA "U.R.E."

INFRA-RED HEATERS

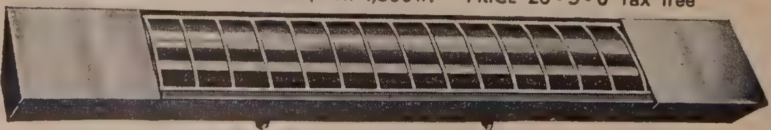
INDUSTRIAL USE ONLY

A heating unit incorporating the latest Silica-Sheathed Element. The low running costs, safety and ease of installation of this type of heater accounts for their enormous popularity for Industrial Premises, Offices, etc.

We take pleasure in announcing our NEW Price REDUCTIONS as and from 14th November 1960



TWIN MODEL: Consumption 1,500w. PRICE £6-5-0 Tax free



SINGLE MODEL: Consumption 750w. PRICE £3-5-0 Tax free

TRADE PRICES ON APPLICATION

USEEKIA (LEVISON & RAWSON) 67 Goldhawk Road, Shepherds Bush, London, W.12 *Phone: SHEpherds Bush 3024*

A Quality Connection

WITH **MONMORE CONDUITS**

FINEST QUALITY
PROMOTES TROUBLE-FREE
LONG LIFE & EASY MANIPULATION

IN
DUCTILE
STEELS
GROUP

Telephone 27091 (5 lines)

MONMORE TUBES LIMITED · WOLVERHAMPTON

Ariel
Brand

BIFURCATED AND TUBULAR

RIVETS

In all Metals & Finishes

S. & D. RIVET Co.
(PROP. STEELS AND BUSKS LTD.)

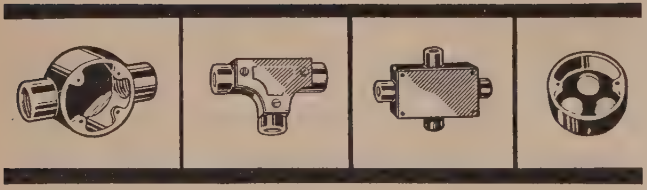
ARIEL WORKS · TEMPLE ROAD
LEICESTER · ENGLAND
TELEPHONE: 36541-5 TELEGRAMS: ARIEL, LEICESTER

ON ALL GOVERNMENT LISTS

SAW SCREWS
UPHOLSTERY
NAILS
DRAWING PINS ETC.

AUTOMATIC
MACHINES
FOR
SETTING
RIVETS

A/88



"All round"
cable protection

METALLIC Conduit Tubes and Fittings give "all round" protection to electric cables. They prevent damage from impact or abrasion . . . and there is a finish and size to meet every need.

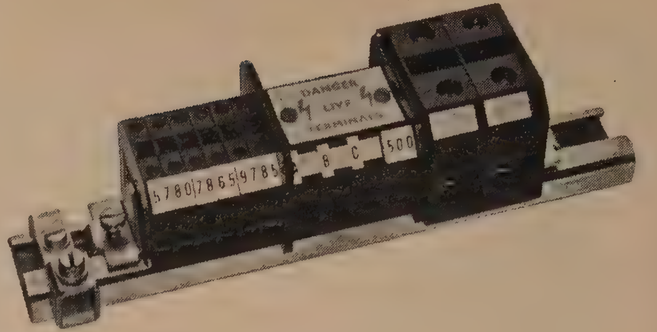
Choose METALLIC for dependability.

METALLIC

CONDUIT TUBES
& FITTINGS

A TI COMPANY

THE METALLIC SEAMLESS TUBE CO. LTD,
LUDGATE HILL, BIRMINGHAM 3
Also at London, Newcastle-on-Tyne,
Leeds, Swansea and Glasgow



OBERTERM *All British*
Control Gear Terminal Blocks

Provide the answer to many of your problems:

- Loads from 25 to 100 amp. in any order.
- Standard Mounting Rail for all sizes.
- Snap-in fixing. No special Tools required.
- High-grade Melamine Mouldings for first-class insulation.
- Special Cable Clamp design to eliminate strand breakage.
- Space saving—100—25 amp. ways in 30 inches.
- Terminal identification simply achieved.

Above are only some of the many advantages that OBERTERM Clip-in terminals offer. Details of these and other types on request.

OBERTERM
ELECTRICAL CO. LTD.

Terminal Works, Kimbolton Road, Higham Ferrers, Northants
Rushden 3677
London Office: 80 New Bond St., London, W.1. Tel: Hyde Park 0728

OVER 60 YEARS OF CABLE MAKING

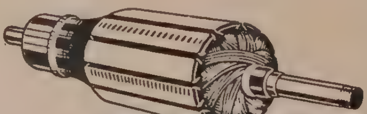
TRADE MARK
EST. 1895

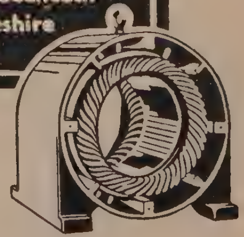
Specialist Manufacturers of
FLEXIBLE CABLES & CORDS
to B.S.S., G.D.E.S., etc., specifications

Lighting, Power, Dynamo, Lifts, Welding and Trailing, V.I.R. and T.R.S., Asbestos and Flame-Resisting Enamel, Silk, Cotton and Glass Insulated Wires, Bare Copper Braids, Non-Rubber Flexibles, Plaited Copper Braids and Cords, P.V.C.-Polythene, P.V.C.-Microphone, Screened, Armoured, etc.

SAXONIA
ELECTRICAL WIRE COMPANY LTD.

Contractors to the Admiralty, War Office and Air Ministry, etc.
Offices and Works: ROAN WORKS, GREENWICH, S.E.10
Grams: "SAXONIST, LONDON." Phones: GREenwich 0463 & 3713
"GREENWICH" CABLES AND FLEXIBLES





ELECTRIC MOTOR
REPAIRS
F.H.P. – 500 h.p. A.C. & D.C

J. B. ELECTRIC LTD.
197/199 Manchester Rd., Broadheath
Altrincham . Cheshire
Phone: Altrincham 2146

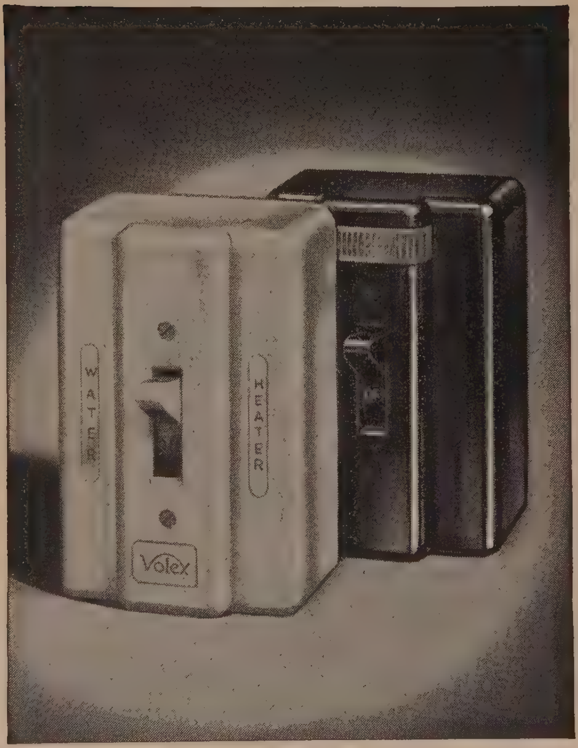
TRANSFORMER REWINDS
10–3,500 K.V.A.
Estimates free – All work guaranteed
Reconditioned Motors ex stock – Reconditioned Transformers to suit your requirements
WRITE FOR DETAILS

Two New Water Heater Control Switches

Volex

D.P. INSULATED SWITCHES WITH EARTH TERMINAL

20 Amp. and 30 Amp.
SURFACE MOUNTING
BROWN OR CREAM FINISH



WITH SELF-CONTAINED MOUNTING BLOCKS

20 AMP. A.C.

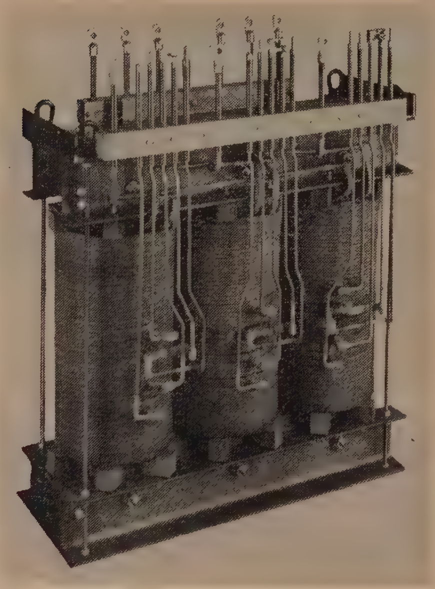
V/5303	Without Pilot light ...	6/8d.	each
V/5303CR	,, ,, Cream	7/8d.	,,
V/5304	With Pilot light	9/-	,,
V/5304CR	,, ,, Cream	10/-	,,

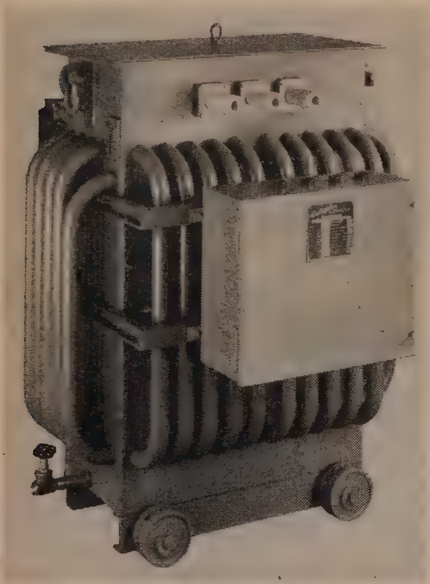
30 AMP. A.C.

V/5203	Without Pilot light ...	7/8d.	each
V/5203CR	,, ,, Cream	8/8d.	,,
V/5204	With Pilot light ...	10/-	,,
V/5204CR	,, ,, Cream	11/-	,,

Volex Electrical Products Ltd.
Telephone: PENDLETON 4373 Salford 6 Telegrams: VOLEXPROD, Salford 6

THE COMPLETE TRANSFORMER SERVICE





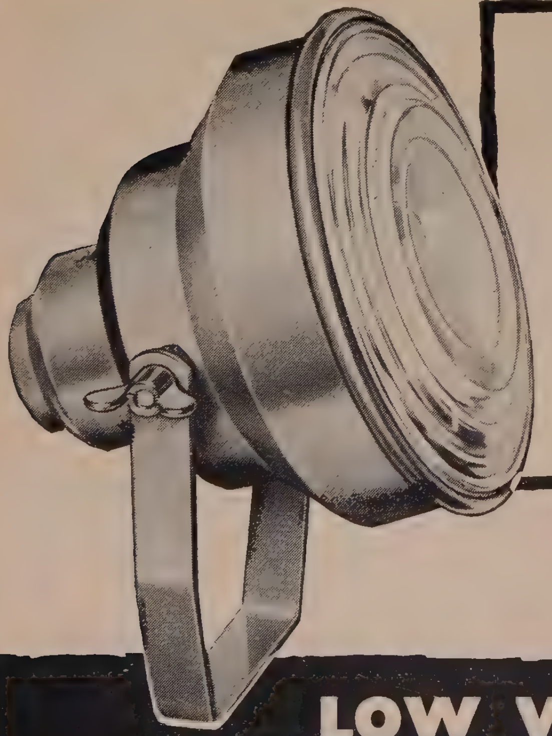
We offer

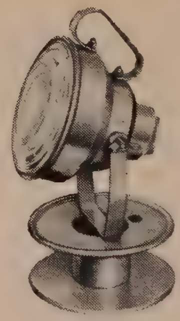
- Electronics Division up to 10 KVA
- Power Division up to 500 KVA
- Metal Working Division Instrument Cases Cubicles, Tanks, etc.
- Resin Encapsulation Division

Enquiries to Technical Sales

A.I.D. and A.R.B. R.C.S.C.
Certificate No. 1160/1

WILLESDEN TRANSFORMER CO. LTD.
MANOR PARK WORKS, MANOR PARK ROAD, HARLESDEN, LONDON, N.W.10
TELEPHONE: ELGAR 5445-6





Designed for use with 38 m.m. vehicle bulbs. This Unit can be supplied with heavy stirrup for fixed mounting, or for transportable use with carrying handle and heavy steel drum stand for housing trailing cable. *Full details on request.*

R.E.A.L. IS A REGD. TRADE MARK

for :—
FIRE TENDERS
EXCAVATORS
CRANES
COMMERCIAL VEHICLES
& MARINE USE

REAL

LOW VOLTAGE HEAVY DUTY FLOODLIGHT

ROWLANDS ELECTRICAL ACCESSORIES LIMITED, R.E.A.L. WORKS, BIRMINGHAM, 18

Classified Advertisements

CLASSIFIED advertisements are PREPAID at 3/6 per line (approx. 6 words).

DISPLAYED CLASSIFIED:—48/- per single column inch.

Where an advertisement includes a Box Number there is an additional charge of 1/-.

SERIES DISCOUNTS for consecutive insertions:—13, 5%; 26, 10%; 52, 15%.

SITUATIONS WANTED:—Three insertions under this heading can be obtained for the price of two if ordered and prepaid with the first insertion.

Cheques and Postal Orders should be crossed and made payable to ILIFFE ELECTRICAL PUBLICATIONS LTD.

REPLIES TO BOX NUMBERS should be addressed to the Box Number in the advertisement, c/o ELECTRICAL REVIEW, Dorset House, Stamford Street, London, S.E.1. If an applicant for a situation appearing under a Box Number does not wish his reply to be forwarded to a particular firm or individual, instructions to this effect should be addressed to the Advertisement Supervisor, ELECTRICAL REVIEW. The name of an advertiser using a Box Number cannot be disclosed.

Advertisements are accepted up to **first post on Monday** of the week of issue

If blocks, bold type or ruled borders are required then on **Friday** prior to week of issue

All communications to be addressed to:
Classified Advertisement Department,
ELECTRICAL REVIEW
Dorset House, Stamford Street
London, S.E.1

Original testimonials should not be sent with applications for employment

OFFICIAL NOTICES, TENDERS, ETC.

CITY OF BELFAST ELECTRICITY DEPARTMENT

Stores

TENDERS are invited for the supply of the undermentioned materials during 12 months commencing 1st May, 1961:—

Form No.

1. Turbine Oil.
2. Insulating Oil for Transformers and Switchgear.
3. Firebricks, Fireclay, Binding Cement for High-temperature Fire Requirements.
5. Carbon Brushes.
6. Steel Wire Ropes.
8. Glazed Stoneware Ducts, Troughing, Pitch Fibre Conduits and Covering Tiles.
9. A.C. Distribution and Street Lighting Control Pillars.
10. 6.6-kV Indoor Metalclad Switchgear.
11. Meters, Instrument Transformers and Ancillary Equipment.
12. Electricity Maximum Demand Indicators.
13. Time Switches.
14. L.T. Fuse Units, Service Cut-Outs and Accessories.
15. Distribution Transformers.
16. Vulcanised Bitumen & Paper Insulated Cables, Joint Boxes, Cleats & Ferrules.
19. Electric Kettles.
21. Electric Cookers.

Forms of tender may be obtained from the Electricity Department, East Bridge Street, Belfast, 1, on payment of the sum of Ten Shillings (non-returnable) for each form. Extra copies of the forms may be obtained at Five Shillings each (non-returnable). Cheques should be made payable to the Belfast Corporation Electricity Department.

All letters, catalogues, drawings, etc., accompanying tenders must be submitted in duplicate.

Tenderers are advised that the Corporation's Conditions of Contract only will apply. Any other conditions put forward by tenderers will not be accepted.

Tenders, in sealed envelope marked "Tender for Stores, Electricity Committee," and endorsed with the name and address of the firm tendering, must reach the undersigned not later than 4 p.m. on Friday, 20th January, 1961.

An official receipt must be obtained for each tender delivered by hand. Tenders sent by post should be registered.

The lowest or any tender will not necessarily be accepted.

JOHN DUNLOP,
Town Clerk.
P.O. Box 234,
City Hall, Belfast, 1.
14th December, 1960. 7129

SKIPTON URBAN DISTRICT COUNCIL

Re-wiring of Electrical Installations

TENDERS invited for re-wiring electrical installations at 83 pre-war Council Houses, Shortbank Road.

Contract documents from Engineer and Surveyor, Town Hall, Skipton, on deposit of £2 2s. (refunded on receipt of bona fide tender).

Tenders, in envelope provided, bearing no indication of sender, to be in by 9th January, 1961.

The Council do not bind themselves to accept the lowest or any tender.

L. E. SMITH,
Clerk to the Council.
7118

DONCASTER RURAL DISTRICT COUNCIL

Trunk Road Lighting Installation

FIXED price tenders are invited from experienced contractors for the supply and installation of a total of 97 Street Lighting units located as follows:—

(i) 44 units on Route A.1 (Great North Road), Rossington Bridge.
(ii) 53 units on Route A.18 (Thorne Road), Edenthorpe.

Each lighting unit will consist of a totally enclosed lantern equipped with a 140-watt sodium lamp, mounted on a 25-ft. prestressed concrete column, together with all necessary auxiliary equipment.

Forms of tender, specifications and bills of quantities may be obtained from, and the conditions of contract and drawings inspected by appointment with the Surveyor to the Council at the address below.

Tenders in plain sealed envelopes endorsed "Trunk Road Lighting, Contract No. 363," must be delivered to the undersigned not later than Friday, 13th January, 1961.

B. MELDRUM,
Clerk to the Council.
Council Offices,
Nether Hall,
Doncaster. 230

WEST LOTHIAN COUNTY COUNCIL

Street Lighting

Trunk Road A.8, in the Vicinity of Bangour Hospital

TENDERS are invited for the supply and erection of 25 200-watt "Long" type enclosed side entry Sodium Lanterns mounted at 35 ft. on tubular steel columns having an outreach of 10 ft. 6 in. on the above Trunk Road.

Copies of the specification, bill of quantities and form of tender may be obtained from the County Electrical Manager, 212, High Street, Linlithgow, West Lothian, where plans of the proposed scheme may be inspected.

Tenders in plain sealed envelopes endorsed "Tenders for Street Lighting, Bangour," to reach the undersigned not later than noon on Saturday, 14th January, 1961.

The Council do not bind themselves to accept the lowest or any tender.

JOHN CALDER,
County Clerk.
County Buildings,
Linlithgow.
14th December, 1960. 7128

FRIMLEY AND CAMBERLEY URBAN DISTRICT COUNCIL

Street Lighting: Supply of Columns and Equipment

TENDERS are invited for the supply of the following:—

(a) Approximately 90 Group "A" Concrete Street Lighting Columns, and/or
(b) Approximately 280 140-watt Sodium Lamps and Lanterns and control gear for same.

Tenders are to be delivered to the undersigned in plain sealed envelopes not later than first post on Saturday, 21st January, 1961.

The Council does not bind itself to accept the lowest or any tender.

K. S. HARVEY,
Clerk of the Council.
Municipal Buildings,
London Road,
Camberley, Surrey.
16th December, 1960. 7148

SITUATIONS VACANT

(See "Replies to Box Numbers" above)

REPUBLIC OF THE SUDAN

APPLICATIONS are invited to fill the post of CONSTRUCTION ENGINEER with the Central Electricity and Water Administration (H.Q.), Khartoum, Sudan.

Applicants should have had a recognised engineering training and preferably be in possession of qualifications leading to Corporate Membership of the Institution of Electrical Engineers. They should have had considerable experience in the installation and maintenance of all kinds of indoor and outdoor substation equipment on systems up to 11 kV. Experience on higher voltage equipment and knowledge of testing and commissioning of protection gear will be an advantage. The successful candidate will be expected to travel about the Administration's supply system to supervise the erection and maintenance of all substation plant and equipment and to train Sudanese in this particular work.

Salary offered is in the present range of £S.1,075-£S.1,675 plus a cost-of-living allowance which is at present approx. £S.187 per annum. An outfit allowance of £S.50 is payable on appointment.

Furnished accommodation is available at a nominal rent of approximately £S.180 per annum, free medical treatment will be provided for official and his family, and free air passages to his home country for leave, which is granted at the rate of 82 days per annum after the first 18 months.

Appointment will be on contract for 5 years including a 12-month probationary period. A bonus of 10% of basic salary earned will be paid at the end of the contract.

Applications, stating age, general and technical education, qualifications and experience, together with particulars of present appointment and salary, should be sent to the Appointments Section, Sudan Embassy, 3, Cleveland Row, St. James's, London, S.W.1.

Closing date, 15th January, 1961. 7141

L.C.C. SOUTH EAST LONDON TECHNICAL COLLEGE

Lewisham Way, London, S.E.4

VACANCIES for (i) LECTURERS and (ii) ASSISTANT LECTURERS (Grade B) in the following subjects:—

ELECTRICAL ENGINEERING.
TELECOMMUNICATIONS.
PHYSICS and MATHEMATICS.

Candidates should have a degree, industrial experience, and preferably some teaching experience.

Salary scales: (i) Lecturer £1,408-£1,601, possible entry above minimum; (ii) Assistant Lecturer (Grade B) £738-£1,201, with additions as approved to a possible maximum of £1,486 for degree, good honours, and suitable full-time study or research. Point of entry dependent on relevant industrial and teaching experience.

The College offers Full-time, Sandwich, Part-time Day and Evening Courses in Electrical Engineering and Applied Physics.

Application forms from the Secretary, returnable within 2 weeks, quoting FE3a/R/3226/12.
7137

***Situations Vacant** (continued)*

SOUTH WALES ELECTRICITY BOARD

District Manager, Rhondda District

APPLICATIONS are invited for the post of Manager of the Rhondda District in the Cardiff and East Central Area.

The District serves an important and varied community in the Rhondda Valley area.

Experience in a senior position in the electricity supply industry is essential, and applicants should possess a recognised professional qualification.

The salary for the position will be in accordance with Class C, Grade 5 of the National Joint Managerial and Higher Executive Grades Committee, namely £2,170-£2,380 per annum.

The successful candidate will be required to commence duties on the 1st March, 1961.

Applications should be sent to the undersigned at St. Mellons, Cardiff, to arrive not later than 16th January, 1961.

Please quote reference 218/60/ER, endorsing envelope "District Manager, Rhondda."

R. G. WILLIAMS,
Secretary. 7133

LONDON ELECTRICITY BOARD

Engineering Draughtsman

APPLICATIONS are invited for the above position in the Board's North Western District at Lithos Road, Hampstead, London, N.W.3.

Candidates should have a good general and technical education and be in possession of the Ordinary National Certificate, be neat and capable draughtsmen, and be experienced in one or more of the following subjects: drawing office routine, electrical diagrams, layout of plant in transformer chambers, mains survey and recording of mains work. A knowledge of building construction would be an advantage.

The post is graded under Schedule A of the National Joint Board Agreement as Class H, Grade 13, £805 to £920 per annum, inclusive of London allowance.

Applications stating age, qualifications and experience, should be sent direct to the Manager, North Western District, Lithos Road, Hampstead, London, N.W.3, to reach his office not later than fourteen days from the publication date of this notice. Please quote reference PER/V/3168/R. 7139

M.K. ELECTRIC LIMITED

have the following vacancies in their Technical Drawing Office:—

DESIGNERS—experienced in the design of small Electrical/mechanical products for large quantity manufacture.

DRAUGHTSMEN—with routine Drawing Office experience and preferably in connection with small electrical products — preparing standard drawings, data sheets, etc.

Excellent working conditions in a new drawing office. Five-day week of 37½ hours. Holiday arrangements honoured and attractive salaries offered according to experience.

Applications treated in strict confidence if addressed to:—

Technical Manager, M.K. ELECTRIC LTD.
Shrubbery Road, Edmonton, London, N.9

7094

CENTRAL ELECTRICITY GENERATING BOARD

Assistant Engineers, Planning Department

APPLICATIONS are invited for the appointment of ASSISTANT ENGINEERS in the System Planning Branch at Headquarters, London, S.E.1.

Candidates should preferably possess technical qualifications at least equivalent to Graduate Membership of the Institution of Electrical Engineers. Practical experience in the electricity supply industry is essential, and knowledge of engineering economics will be considered an advantage.

The work of the System Planning Branch is primarily concerned with the initiation and co-ordination of programmes of new generating plant and main transmission. The successful candidates will be required to assist with the study of factors affecting these future developments.

Salaries on scales within the range £1,395-£2,010 per annum, according to duties and responsibilities.

Applications stating age, qualifications, experience, present position and salary to the Personnel Officer, 24/30, Holborn, London, E.C.1, by 9th January, 1961. Envelopes should be marked "Confidential Ref. ER/460." 7135

SOUTH WESTERN ELECTRICITY BOARD

APPLICATIONS are invited for the following position:—

THIRD ASSISTANT DISTRICT ENGINEER (Planning),
West Cornwall.

Salary according to Class G, Grade 9, Salary Scale 7 (£965 to £1,090 per annum) of the N.J.B. Agreement.

The successful candidate will be required to assist in the planning work of a large, mainly rural, distribution system, together with the preparation of capital applications and estimates. The person appointed will be required to undertake standby duties.

A sound knowledge of construction methods and of all types of plant and equipment is necessary. Possession of the Higher National Certificate in Electrical Engineering is desirable, and possession of a current driving licence will be an advantage.

Applications to be made on standard form AE6/ACT, OBTAINABLE BY POSTCARD ONLY from the District Manager, South Western Electricity Board, 13, Basset Road, Camborne, Cornwall. Closing date for receipt of completed applications is 14th January, 1961. 7136

EAST MIDLANDS ELECTRICITY BOARD

Ilkeston and North Derbyshire Sub-Area

SECOND ASSISTANT DISTRICT ENGINEER, Matlock District
(Vacancy No. 139/60).

Salary N.J.B. Class F, Grade 7, £1,040 × £25 to £1,165 per annum.

The duties will include assisting with the planning of underground and overhead distribution systems, including the layout of substations and the preparation of schemes on voltages up to and including 11 kV.

Applications should be forwarded to the Manager, Matlock District, Glendon, Knowleston Place, Matlock, Derbyshire, within fourteen days of the date of this advertisement.

Coventry Sub-Area

SENIOR ASSISTANT
(Stores Accounts)
(Vacancy No. 143/60).

Salary N.J.C. Grade 4, £890 × £30 to £1,010 per annum.

The successful applicant will be responsible to the Principal Assistant (Expenditure) for stores recording methods, stores ledger controls including liaison with the Hollerith machine section, stock levels and reviews of slow-moving stocks, collaboration with technical officers in operating standard stocks, and the preparation of information for the General Accountancy Group.

A good appreciation of accountancy principles is essential and the possession of the intermediate examination of a recognised professional body would be an advantage.

Applications should be forwarded to the Manager, Coventry Sub-Area, Sandy Lane, Coventry, within fourteen days of the date of this advertisement. 7138

AIR MINISTRY

ASSISTANT MECHANICAL AND ELECTRICAL ENGINEERS required for design, construction and maintenance of installations on airfields, radar stations, missile bases, workshops and maintenance units for the R.A.F. at home and overseas as well as certain Civil Airports.

Salary £805 at 25 to £1,095 at 34 or over, thereafter rising to max. £1,260 with increase for London and slight decrease for country districts. Appointments long term with promotion and pension prospects. 5-day week with 4 weeks 2 days leave a year initially. Special allowances payable in addition to salary during overseas service.

Minimum qualifications and experience :—

(i) (a) University degree or equivalent diploma in electrical and/or mechanical engineering with at least 2 years' apprenticeship; or

(b) Graduate or Corporate Member of I.E.E. with at least 3 years' apprenticeship; or

(c) Graduate or Corporate Member of I.Mech.E., appreciable electrical engineering experience, with at least 3 years' apprenticeship; and

(ii) have been employed for minimum of 2 years with well-established engineering concern and gained wide experience in both electrical and mechanical engineering practice.

Applicants must be natural-born British subjects between the ages of 25 and 45. Forms from Ministry of Labour, Technical and Scientific Register (K), 26, King Street, London, S.W.1, quoting D.158/OA. 248

CITY AND COUNTY OF NORWICH

ASSISTANT ELECTRICAL ENGINEER required. Salary A.P.T. III (£935-£1,140) according to experience and qualifications.

Applicants must have the Higher National Certificate or be graduates of the Institution of Electrical Engineers, have served an apprenticeship in electrical installation work, and have experience in the design and supervision of interior lighting and power installations.

Applicants should state age, qualifications, training, experience, present and previous positions, together with the names of two referees.

Housing accommodation will be considered in approved circumstances.

Applications to the City Engineer, City Hall, Norwich, NOR. 01A, by 13th January, 1961.
7149

BICC

wish to appoint a

SENIOR ELECTRIC ENGINEER

for an important position within the Organisation

This appointment is based on London and applications are invited from experienced Engineers having an engineering degree or recognised equivalent. Candidates should be capable of operating at executive level and taking complete charge of a department concerned with the design and development of heating cables and allied equipment. Salary will be commensurate with the responsibilities of the position. 5 day week. Pension Fund.

Applications with full details of training and experience should be sent to the:

Personnel Officer
BRITISH INSULATED CALLENDER'S CABLES LTD.
21 Bloomsbury Street
London, W.C.1

7131

CENTRAL ELECTRICITY GENERATING BOARD

Eastern Division

APPLICATIONS are invited for the following appointment:—

ASSISTANT ENGINEER,
BRADWELL (Essex)
NUCLEAR GENERATING STATION
(Staff Vacancy No. 1418).

Salary N.J.B. Class M, Grade 12, Scale 9, £1,115-£1,245 per annum.

The successful candidate will normally be engaged on general operational duties on day work but will from time to time be required to work on shift for which an addition of 10% will be made to the salary.

Experience in the operation of modern generating station plant and qualifications to H.N.C. will be an advantage.

Applications, quoting reference S.V. No. 1418, stating age, qualifications, experience and present position, should be sent to the Controller, Central Electricity Generating Board, Eastern Division, West Farm Place, Chalk Lane, Cockfosters, Barnet, Herts., to arrive not later than 7th January, 1961. 7162

CAMERON HIGHLANDS HYDRO-ELECTRIC SCHEME—MALAYA

WELDING INSPECTOR

Required by Consulting Engineers for site construction, STAFF INSPECTOR OF WORKS to oversee primarily the erection of high-pressure welded conduits and tunnel linings.

The work would be entirely in the field.

The applicant should be experienced in supersonic methods of flaw detection, being a member of the Institute of Welding and holding recognised certificates for arc and gas welding.

The appointment would be for approximately 2 years commencing in mid-1961. Passages provided, free medical attention, transport allowance and concessionary housing, salary not less than £1,900 p.a.

Applications should be made in writing within 14 days of the publication of this advertisement, giving full details of previous experience, age, marital status, etc., to Preece, Cardew & Rider, Consulting Engineers, 8, 10 & 12, Queen Anne's Gate, London, S.W.1.

7132

LONDON ELECTRICITY BOARD

Chief Engineer's Department,
Design and Planning Branch

APPLICATIONS are invited for the following posts in the Board's Engineering Drawing Office at Lesco House, Stamford Street, London, S.E.1.

SENIOR DRAUGHTSMAN
(Ref. PER/V/3169/R).

Graded under Schedule B of the National Joint Board Agreement as Class BX, Grade 9, £1,055/£1,375 p.a., inclusive of London allowance.

Candidates should have a good general and technical education and possess the Ordinary National Certificate in Electrical or Mechanical Engineering, and preferably have served an engineering apprenticeship. They should be experienced in the design and layout of main substations incorporating transforming plant and switchgear for capacities of 60 MVA and above.

ENGINEERING DRAUGHTSMEN
(Ref. PER/V/3170/R).

Graded under Schedule B of the National Joint Board Agreement as Class BX, Grade 12, £820/£1,140 p.a., inclusive of London allowance.

Duties will include the design and layout of main substations, and candidates should have a good general and technical education and possess the Ordinary National Certificate in Electrical or Mechanical Engineering. They should have experience appropriate to the post and preferably should have served an engineering apprenticeship.

Application forms obtainable from the Personnel Officer, 46, New Broad Street, London, E.C.2, to be returned completed within fourteen days of the publication date of this notice. Please quote appropriate reference. 7140

MERSEYSIDE AND NORTH WALES ELECTRICITY BOARD

THIRD ASSISTANT COMMERCIAL ENGINEER required at the Board's No. 2 Sub-Area Headquarters, Sandiway House, Northwich, Cheshire. Salary within range £1,190/£1,325 per annum (N.J.B. L/10).

Applicants should have completed a recognised electrical engineering apprenticeship, and be in possession of at least the Higher National Certificate in Electrical Engineering. Experience in operating a contracting department and carrying out negotiations with all classes of consumers would be an advantage.

Duties will include generally assisting with the technical and administrative work in the Sub-Area Commercial Department, particularly with development in the utilisation of supply by commercial, agricultural and industrial consumers.

Appointment subject to medical examination. Pension scheme.

Application forms obtainable from the Manager, No. 2 Sub-Area, at the above address. Closing date, 6th January, 1961. 7154

CENTRAL ELECTRICITY GENERATING BOARD

ASSISTANT ENGINEER,
ELECTRICAL PLANT

required in the POWER PLANT DESIGN BRANCH. The branch is responsible for the design of boiler, turbo-generator and ancillary plant in conventional power stations, and for the design of plant other than reactors and their ancillaries in nuclear power stations. It is staffed mainly with engineers specialising in individual items of power plant, or in particular aspects of those items, and works in close collaboration with those responsible for the operation of the Board's power stations.

Duties will be to assist in analytical and technical investigations into design problems associated with rotating electrical plant for installation in power stations.

Candidates should have a degree in electrical engineering and/or Corporate Membership of the I.E.E., with a sound knowledge of the principles of electrical machine design and some manufacturing and test experience with large alternating current rotating machines.

Salary within the range £1,460-£1,890 p.a.

Applications stating age, qualifications, experience, present position and salary should be forwarded to the Personnel Officer, 24/30, Holborn, London, E.C.1, by 16th January, 1961. Envelopes should be marked "Confidential, Ref. ER/435." 7134

BAHAMAS ELECTRICITY CORPORATION

Applications are invited for the position of

DISTRIBUTION CONSTRUCTION ENGINEER

with the Bahamas Electricity Corporation in Nassau. Applicants must be Graduate Members of the Institution of Electrical Engineers and have had experience in both underground and overhead construction work on an electricity supply distribution system.

The contract will be for a period of three years with a possibility of renewal or permanent appointment.

Salary will be £1,760 per annum.

Official housing is not available but a rent allowance will be paid equal to £65 per month less 15% of the officer's monthly salary.

Tourist class return air passages will be provided for the officer and his wife and family up to a maximum of three adult fares.

Upon satisfactory completion of the contract the person engaged will be entitled to 28 days' full pay leave for each year of service and in addition a gratuity equal to 10% of his annual salary for each year of completed service.

Two weeks' local leave may be granted annually at the discretion of the General Manager.

There is at present no income tax in the Bahamas.

The successful applicant will be provided with official transport but will be required to undertake standby duty on a rota with other members of the distribution staff.

Applications should be sent in the first instance to the General Manager, Bahamas Electricity Corporation, c/o General Post Office, Nassau, Bahamas, and the envelope endorsed "Distribution Construction Engineer."

Closing date for applications will be 9th January, 1961.

7107

***Situations Vacant** (continued)*

TECHNICAL SALES ENGINEER

required by old-established manufacturer of Rotary Electrical Equipment.

The candidate should have considerable knowledge of electric motors and generators and their application, and should preferably hold the Higher National Certificate or equivalent qualification.

This is a senior appointment which will admit to the company's monthly staff pension scheme.

Please write, giving full particulars, to:

Sales Director
SMALL ELECTRIC MOTORS LTD.
Churchfields Road, Beckenham, Kent
7150

NORTH EASTERN ELECTRICITY BOARD

Area Board Headquarters

APPLICATIONS are invited for the appointment of a THIRD ASSISTANT ENGINEER, Technical Section, Chief Engineer's Department, with location at Newcastle upon Tyne. Applicants should be suitably qualified engineers and have had experience in testing, commissioning and maintenance of electrical measuring instruments and protective equipment. Knowledge of the design of electronic devices and circuits will be an advantage.

Salary Schedule B, Class AX, within the range of Grades 8 to 6, £1,105/£1,500 per annum. N.J.B. conditions of service.

Applications stating age, qualifications and experience to be received by the Assistant Secretary (Establishments), North Eastern Electricity Board, G.P.O. Box No. 117, Carliol House, Newcastle upon Tyne, within ten days of the appearance of this advertisement. 7153

SOUTH EASTERN ELECTRICITY BOARD

ELECTRICAL FITTER, Folkestone and Ashford District. Normally based at Ashford, but must be prepared to work in any part of the District. Wages 5s. 6¾d. per hour for 42-hour week under N.J.I.C. Agreement. Applicants should be able to work to drawings and should be experienced in the erection and maintenance of E.H.V. and M.V. switchgear and transformers.

Applications, quoting ER and naming two referees, to District Manager, SEEBOARD, York House, Cheriton Gardens, Folkestone, Kent, by 11th January, 1961.

ASSISTANT DISTRICT ENGINEER, Woking District. Salary under N.J.B. Agreement, Class F, Grade 7, £1,040 - £1,165 per annum. Superannuable. (Reclassification to Class G possible from 1st April, 1961). Applicants, preferably qualified to H.N.C. Electrical Engineering standard or equivalent, must have had practical training and experience in general distribution work on systems up to 11 kV, and be capable of organising and supervising a full construction and maintenance programme. Ability to plan and prepare schemes for mains extensions would be an advantage. Consideration will be given to a private car allowance and, in appropriate circumstances, to assistance with housing.

Applications, quoting ER, on forms from Woking Manager, SEEBOARD, 4, Chobham Road, Woking, by 11th January, 1961.

ASSISTANT ENGINEER, Guildford District. Salary £1,040-£1,165 under N.J.B. Class F, Grade 7. Superannuable. Preference given to applicants with technical qualifications up to H.N.C. standard and with practical experience of the planning, construction, operation and maintenance of MV and 11-kV underground and overhead systems. Consideration will be given to a private car allowance and assistance in house purchasing in appropriate circumstances. The successful applicant will be required to undertake standby duties.

Applications, quoting ER, on forms from District Manager, SEEBOARD, Woodbridge Road, Guildford, Surrey, by 11th January, 1961.

GEORGE WRAY,
Secretary. 7160

SENIOR ESTIMATOR — ELECTRICAL

An Expanding and progressive company situated near Birmingham requires a qualified Electrical Engineer (H.N.C. or equivalent) to take charge of all tendering and quotations. The work is concerned with electrical products in the heavy field, mainly on transmission and sub-stations. Applicants must have experience in these fields and be capable of analysing tendering documents and preparing estimates and quotations, as well as organising a department. Initial salary up to £1,500 with excellent prospects.

Reference number 142.

SENIOR ELECTRICAL ENGINEER

Important British Mining Company in West Africa requires a qualified senior Electrical Engineer with experience of power generation and distribution, preferably in relation to mining engineering. He would be responsible to the Chief Engineer for the maintenance of all electrical plant and machinery on the surface and underground and for the installation of all new electrical equipment. Starting salary £1,800/£2,000; non-contributory pension scheme; 15 months' tours, followed by 3 months' leave. Furnished bungalow and car are provided and passages paid. Age 28-40.

Reference number 143.

Please reply in confidence, quoting reference number to:

C Robert Clive (Consultants) Limited

Appointments Consultants

27 ALBEMARLE STREET, LONDON, W.1 7130

BRITISH ENGINE BOILER & ELECTRICAL INSURANCE CO. LTD.

98, West George Street, Glasgow, C.2

ELECTRICAL SURVEYOR required for Scotland. Permanent position carrying progressive salary scale £825 to £1,225, with non-contributory pension. Candidates, age 26 to 32, with H.N.C. in Electrical Engineering or Grad. I.E.E., and with apprenticeship in manufacture or repair of electrical machinery, are invited to apply stating age, qualifications and experience. 7143

PRODUCTION SUPERINTENDENT

required by Rubber and Thermoplastic Cable Makers

CANDIDATES should be age 30/40. Experience in control of factory labour, a knowledge of rubber cable technology, and an H.N.C. or equivalent in engineering are desirable qualifications.

Applications, giving full details of previous experience, should be sent to the Secretary, W. T. Glover & Co. Ltd., Trafford Park, Manchester, 17. 7155

HAPPY IN YOUR RUT?

YES? Well, this advertisement will not interest you, but for those seeking fresh fields for expression of talent and individuality as

PRODUCT DEVELOPMENT & RESEARCH ENGINEERS

we can offer permanent pensionable positions with four-figure commencing salaries and excellent advancement potential. The successful applicants, age 30 plus, will be required to develop an interesting range of electric motor control gear widely used in a variety of applications from guided missiles to paper manufacturing machinery.

Vacancies also exist for engineers below this grade.

West London company.

Please write in confidence giving details of age, experience, qualifications, etc., to—Box 7048.

CHELTENHAM AND GLOUCESTER JOINT WATER BOARD

Appointment of Electrician at Mythe Waterworks, Tewkesbury

APPLICATIONS are invited from suitably qualified and experienced persons for the above appointment. Preference will be given to candidates having experience of the maintenance of large horse-power electric motors and associated equipment.

The N.J.I.C. rates will apply for Engineering Craftsman, which are £11 6s. 7½d. for a normal 5-day week of 42 hours. (Rate of pay 5s. 4¾d. per hour). Normal overtime rates will apply. In addition, a rent and rates free house is available.

The successful applicant will be required to join the Board's superannuation scheme.

Applications to be submitted to the undersigned not later than noon on Monday, 2nd January, 1961.

W. E. C. BIRD,
J. H. GOODRIDGE,
Joint Engineers.

P.O. Box No. 12,
Municipal Offices,
Cheltenham. 7110

CITY OF BIRMINGHAM PUBLIC WORKS DEPARTMENT

Mechanical and Public Lighting Section

Vacancy for Electrical Engineer, Grade A.P.T. IV, £1,140/£1,310 p.a.

APPLICANTS should be Associate Members of the Institution of Electrical Engineers or hold the Higher National Certificate, or the Diploma of the Illuminating Engineering Society (with 5 years' experience).

Candidates should have experience of lighting engineering with particular reference to public lighting.

The post is permanent, superannuable and subject to a medical examination.

Applications stating qualifications, age and experience, and naming two referees, should reach the undersigned by the 14th January, 1961.

Canvassing disqualifies.

HERBERT J. MANZONI,
City Engineer and Surveyor.

Civic Centre,
Birmingham, 1.
16th December, 1960. 7159

CLASSIFIED ADVERTISEMENTS ARE PREPAID

CHARTERED ELECTRICAL ENGINEER

A VACANCY exists for a Chartered Electrical Engineer, age 30 to 35, with a Hydro-Electric Power Undertaking in Northern Nigeria. Pleasant climate 4,000 feet above sea level.

Salary grade £1,335/£1,565 according to age, qualification and experience. Pension and life assurance scheme. Eighteen months' tours with three months' leave on full salary. Free furnished quarters. Free passages self, wife and two children, or equivalent benefits if children remain at home.

Write Box E.996, c/o Streets, 110, Old Broad Street, London, E.C.2. 7054

AN experienced outside sales representative of good education and with a sound electrical background, is required by Crompton Parkinson Limited, to sell their Induction Motors on his own initiative in the Hull area. This is a staff appointment, carrying a good salary and pension benefits. Please apply for application form to MA/P2, Crompton House, Aldwych, London, W.C.2. 7127

ASSISTANT electrical engineer required for modern expanding Midlands company. H.N.C. or better is essential, with a sound practical experience of A.C. and D.C. motor control schemes, M.T. distribution layouts, lighting and heavy industrial installations. Salary in accordance with qualifications and experience.—Box 7151.

CABLE engineer, experienced in the manufacture and design of impregnated, paper-insulated, solid-type power cables of all voltages, required as liaison engineer. Duties will involve the technical aspects of standardisation. rationalisation procedures and quality control. Please write with full details of experience, qualifications, etc., to the Staff Officer, ref. 736/55/ER., Associated Electrical Industries Ltd., London, S.E.18. 7098

DRAUGHTSMEN for electrical and mechanical detail and layout work. Commencing salary dependent on age, experience and qualifications up to £900 per annum.—Fuller Electric Ltd., Fulbourne Road, Walthamstow, London, E.17. 7158

ELECTRICAL breakdown man required in January. Minimum rate 6s. 6½d. per hour plus 4-room flat accommodation in North London.—Box 188.

ELECTRICAL engineer required for Glasgow office staff, age 23-28. Applicants (H.N.C. minimum) should have had experience in the manufacture of electrical machines. Progressive salary with non-contributory pension. Applications stating age, nationality, qualifications and experience to—British Engine Boiler & Electrical Insurance Co. Ltd., 98, West George Street, Glasgow, C.2. 7144

ELECTRICAL engineers and contractors require senior estimating engineer for Glasgow area. Write giving details of training, experience, present position and salary to—Box 7697.

ELECTRICIAN required for plantations company in Liberia, West Africa. Age 30/45, married/single, with at least 5 years' experience, able to supervise and if required carry out all types of electrical work, from ordinary wiring to operating hydro plant. Previous experience abroad and handling of native workmen preferable. Housing and car provided. Salary $500 per month.—Box 7145.

ESTIMATING, site supervising and design engineer required for high-class installation work of all descriptions. Permanency and good immediate prospects for keen and able engineer. Write stating age, experience and salary required to—Mr. C. King, Alliance Electrical, 2, Henrietta Street, London, W.C.2. 137

GREENGATE & IRWELL RUBBER Co. Limited require an energetic young man experienced in estimating in rubber and plastic cables, and with knowledge of mains cables, for their cable sales office. Excellent opportunity to gain further experience in a broad field. Applications, which will be treated in confidence, giving full details of education and career, should be sent to the Secretary, Greengate Works, Manchester, 3. 7161

HIGHLY competent, very experienced works manager required for factory in South America making electric cable and copper wire. Temperate climate, good salary and low taxation. Apply giving qualifications, experience and personal particulars to—Box 7163.

INSTRUMENT makers required, fully skilled and able to work to drawings and specifications. Apply, quoting ref. FD/527/2, to—Personnel Officer, Decca Radar Ltd., Shannon Corner, New Malden, Surrey. 7157

M.K. ELECTRIC Ltd. invite applications for position of area sales representative for East Anglia covering the counties of Norfolk, Suffolk, Cambridge and part Essex. Applicants must have good education and preferably a thorough knowledge of the marketing and distribution of electrical accessories. Applications, giving full particulars of past experience, age and salary required, will be treated in strict confidence if addressed to the Sales Manager, M.K. Electric Ltd., Shrubbery Road, Edmonton, London, N.9. 7142

RADIO and television engineer wanted for old-established radio shop with all leading agencies. Write stating age, experience and salary required.—The Music Box, 89, London Road, London, S.E.1. 7090

SALES (technical) engineer with all-round technical training required by small group of companies. Initial salary, prospects good. In first instance write for particulars only to—J. Dootson, Grand Bldgs., London, W.C.2. 7156

SIMPSON BROS. (of Hapton) Ltd. have a vacancy for an assistant manager for electrical contracting department. Must be experienced in large industrial and commercial contracts. Excellent opportunity for the right man. Apply—Simpson Bros. (of Hapton) Ltd., Hapton, Burnley, Lancs. 7116

TRANSFORMER designer to lead and control design and drawing office. A person of wide experience coupled with ability and enthusiasm is required. The position carries commensurate salary and promising future. Apply in writing—Willesden Transformer Co. Ltd., Manor Park Road, Harlesden, London. N.W.10 (ELGar 5445). 309

APPOINTMENTS FILLED

Dissatisfaction having so often been expressed that unsuccessful applicants are left in ignorance of the fact that the position applied for has been filled, may we suggest that Advertisers notify us to that effect when they have arrived at a decision? We will then insert a notice free of charge under this heading.

SITUATIONS WANTED

PAPER mill chief electrical engineer seeks change. Experienced in design, planning, installation and maintenance. Ex-Harland sectional drive specialist.—Box 7690.

SALES representative, aged 38, redundant due to merger, experienced cable industry and electrical/engineering products. Good administrator and correspondent. Resident Leeds but would move.—Box 7691.

TECHNICAL representation in S.E. offered by qualified electrical engineer on freelance or part-time basis; own office, transport, etc.—Box 7688.

ARTICLES FOR SALE

HOUSE SERVICE METERS

200-240-v. A.C. or D.C., 10 amps. capacity, quarterly type, from 25s. each, plus 2s. 6d. carr.

UNIVERSAL ELECTRICAL CO.
221, City Road, London, E.C.1 37

A.A. ELECTRICAL Co. for A.C.-D.C. motors, switchgear, exhaust fans, hoists, reduction gears, new or reconditioned units.—CHI. 5105. 67, Rothschild Rd. London W4. 57

A BABCOCK & Wilcox water tube boiler will cut down your fuel costs; we can supply from stock. Two 40,000 lb. evap., 220 lb. w.p.; one 25,000 lb. evap., 200 lb. w.p.; 3,000 lb. evap., 100 lb. w.p.; Spencer Bonecourt boiler; also Marine, Cornish, vertical, etc.—Burford, Taylor & Co. Ltd., Boiler Specialists, Burtayco House, Church Street, Middlesbrough (Tel. Middlesbrough 2622). 122

A.C. and D.C. motors, generators, from stock.—Service Electric Co. Ltd., Honeypot Lane, Stanmore, Middx. (Edgware 5566/9). 91

A.C. and D.C. 1/- slotmeters. Guaranteed 2 years, 2½-50 amps. From 55/-. Repairs and recalibrations. See Billiard: Tradex Meter Co., Surbiton (Tel. Elmbridge 2234/5/6). 169

ALTERNATORS and generators, all types up to 150 kW.—Powerco Ltd., 312, York Road, London, S.W.18 (VAN. 5234). 151

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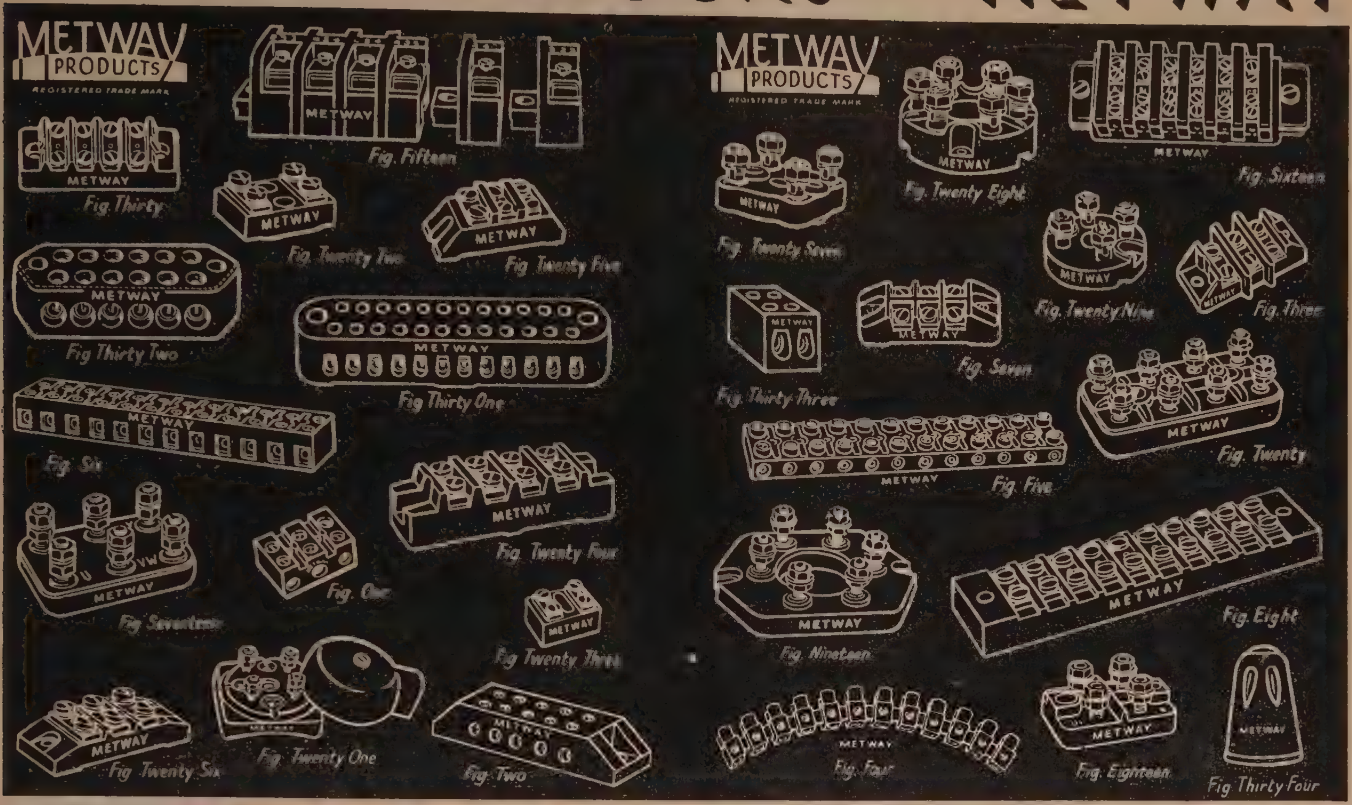

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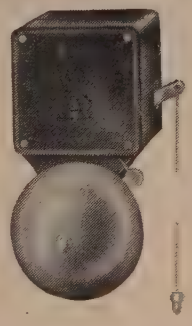

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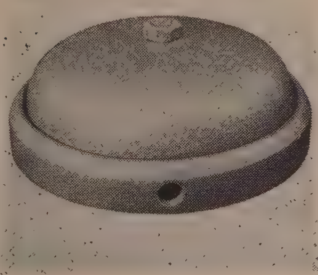

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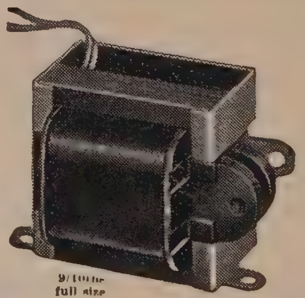

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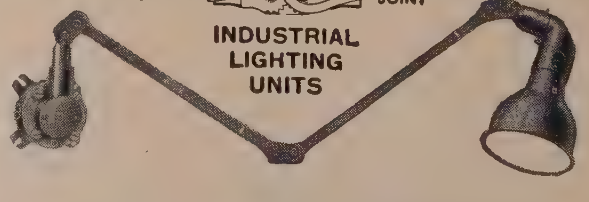

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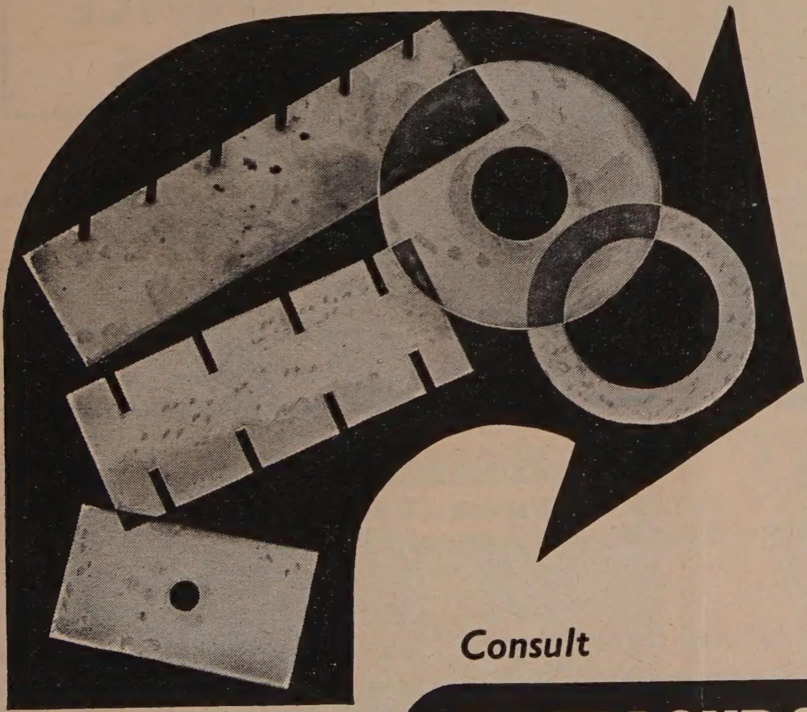

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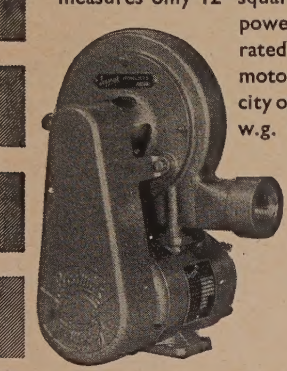

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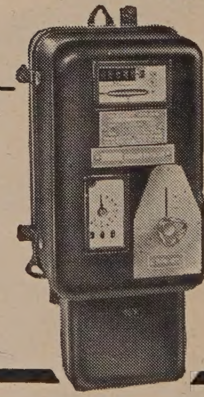

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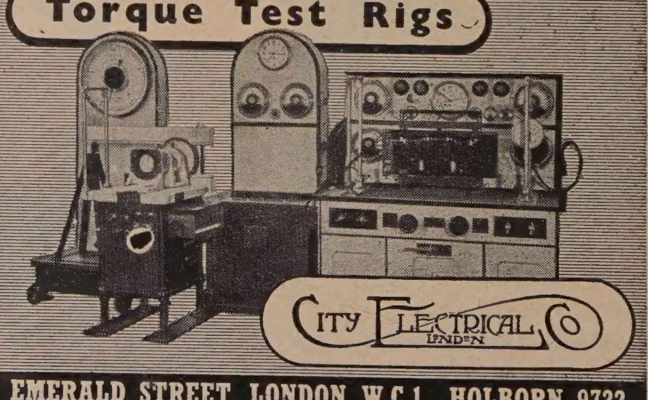

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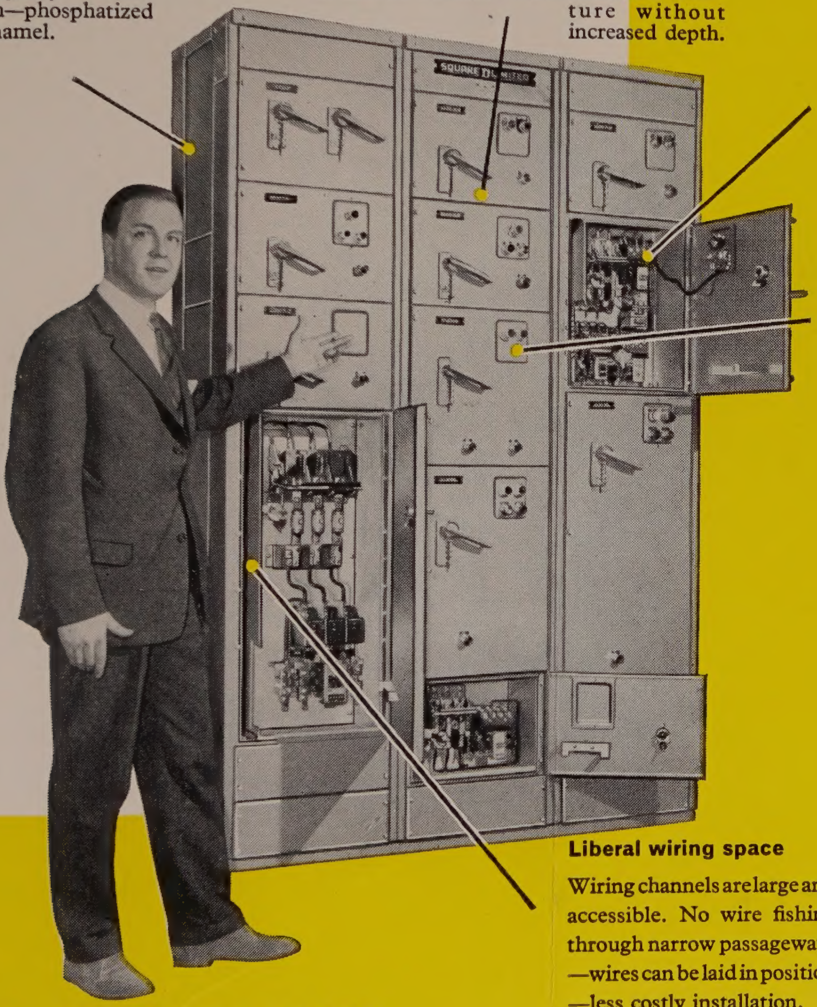

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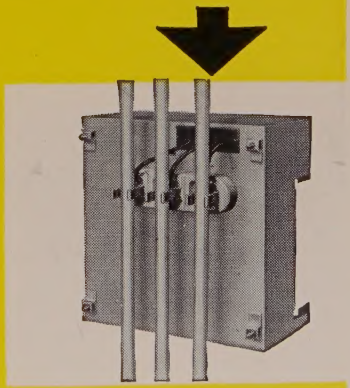
Tubular vertical buses feed plug-in units
Another Square D "exclusive"—inherently stronger—greater cooling surface. Extra-wide spacing between phases gives added "breakdown" protection. Plug-in stabs are silver-plated copper backed by steel springs—give high pressure, low resistance contact at all times. Bus bars are also silver plated.



Liberal wiring space
Wiring channels are large and accessible. No wire fishing through narrow passageways—wires can be laid in position—less costly installation.

GET THE COMPLETE STORY

BULLETIN 8998 gives detailed information on all of the "plus" advantages you get when you specify Square D motor control centres. Send for a copy.

Leaders in Control Gear for over 50 years

To have the best Specify Square D

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CHENEY MANOR SWINDON WILTSHIRE

Square D products are stocked by leading electrical wholesalers throughout Great Britain

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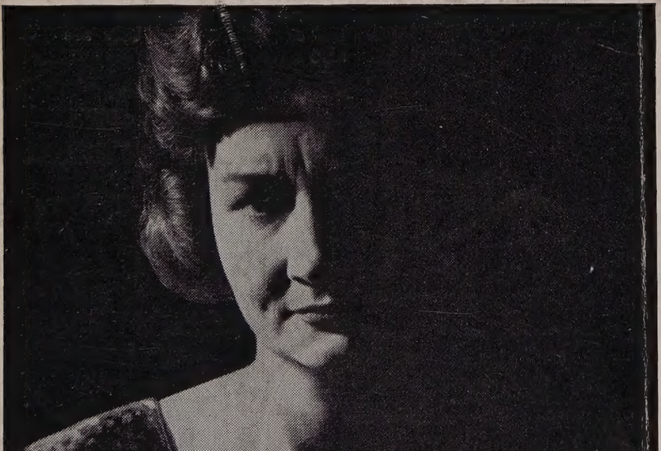

Why 4 out of 5 women go for

Mazda

Netabulb

4 out of 5 women prefer a smaller bulb that has a neater, trimmer shape

They go for NETABULB

4 out of 5 women like a bulb that's snug in the smaller modern fittings

They go for NETABULB

4 out of 5 women prefer a bulb whose whiter light is kinder to the eyes

They go for NETABULB

This may be an advertisement, but it's certainly no pipe-dream that "4 out of 5 women, given a choice, prefer the Mazda NETABULB". So say the Market Research men who did the counting in a recent independent survey.

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